BIOANTHROPOLOGICAL INVESTIGATION OF THE VAULTS AT ORTON PLANTATION, BRUNSWICK COUNTY, NORTH CAROLINA

Chicora Research Contribution 560

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MANAGEMENT SUMMARY

During the architectural conservation efforts on the Orton burial vaults (31BW787**2) it became necessary to open the vaults to make repairs. These repairs, however, would cause damage to any skeletal remains present in the vaults. Consequently, a detailed research design was prepared that would allow conservation efforts, after the vaults were opened and their associated skeletal remains and other artifacts were carefully removed. After both the repair of the vault and the analysis, all of the identified remains were placed in new caskets and replaced in their appropriate vault. The vaults were then resealed.

These investigations provided an unprecedented opportunity to examine a colonial population from the lower Cape Fear, as well as their associated burial hardware, and the construction of the vaults.

While vaults similar to those at Orton are found in neighboring South Carolina and extending into Georgia, the style does not seem to be found elsewhere in North Carolina or further north. One possibility to explain this distribution is that the Orton-style vaults are associated with Anglicans, perhaps from the Barbados. However, Harold Mytum notes that the vault style was used by wealthy Irish families. Since Roger Moore traced his lineage to Nathaniel O'Moore (1620-1680), there may be good reason for the similarities.

Unfortunately, only Vaults 3 and 4 can be dated with any degree of certainty and this is only because we believe that they house individuals with known death dates (Catherine Rhett, who died in 1745, in Vault 3 and Roger Moore, who died in 1751, in Vault 4).

All of the coffin wood from Orton was identified as pine. The coffins are all hexagonal with flat tops, although two varieties were identified. For most of the coffins the breaks were sharp; the coffin of Roger Moore, however, revealed breaks that were flowing or more graceful.

Decorations were limited to brass tacks. Coffin handles were present for the Orton burials and all were wrought iron mounted on backplates. Not all of the handles, even on a single coffin, were identical, suggesting the limited availability of handles.

All of those buried were in shrouds. The few identified pins were likely used to attach caps or face veils, rather than to close shrouds, which were usually tied or knotted.

The skeletal remains from the four vaults at Orton revealed the presence of 11 individuals: one adult male, two adult females, one teenaged male, and seven infants (two males, four females, and one of unknown sex). The individuals were subjected to DNA studies, revealing that the interments include Roger Moore, his adult sister and four of her children, an adult woman who may have been his wife Catherine, and four unidentified infants.

Several of the infants had decayed teeth in the pattern today called "bottle mouth"; tooth development indicated that at ages 8-16 months each was taken off breast milk and hand-fed resulting in extensive dental decay.

The burial of Roger Moore was the only one suitable for parasite analysis and it produced no evidence for any associated parasites, even though parasites are generally thought to be ubiquitous during this period. The failure to encounter parasites is strongly suggestive, although not conclusive, that Roger Moore was in robust health and the plantation exhibited overall good sanitation.

The remains of Roger Moore also allowed a facial reconstruction by a forensic artist. Thus, for the first time we have been able to place a face on the famous “King” Roger Moore.

Samples of the four adult Orton samples were examined for lead content using ICP-MS. The results, ranging from 190 to 340 μg PB/g ash, represent the highest we have identified in the reported literature. These results suggest that the Moore family was exposed to very high lead levels consistent with their high social status. The difference between males and females also suggests differential access.

Stable isotope analysis using the carbon isotopes ^{12}C and ^{13}C and the nitrogen isotopes ^{14}N and ^{15}N were also conducted on the four adult skeletons. The findings are suggestive a meat and corn rich diet with little use of marine resources. The results are consistent with recent studies of other very high status colonial individuals.

The skeletal evidence suggests that the individuals interred in the Orton Cemetery were healthy and well nourished, with no evidence of trauma (with the exception of one individual who lost a tooth in childhood). When compared to other colonial populations, the individuals at Orton were extremely healthy.

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Introduction

This project involved the identification, and analysis of burials from the four brick vaults at Orton Plantation cemetery in Brunswick County, North Carolina (31BW787**2). The field investigations were conducted intermittently by Chicora staff between November 2013 and January 2014, with analysis of the remains conducted from February through April 2014. DNA analysis was conducted from February through September 2014 by Lakehead University Paleo-DNA Laboratory in Thunder Bay, Ontario. This report was completed by Chicora staff between August and December 2014 and received limited revisions in November 2015.

The cemetery is situated in eastern Brunswick County, south of Wilmington, North Carolina in neighboring New Hanover County (Figure 1). It is located on the original 3,000 acre Orton Plantation assembled by its first owner, Roger Moore, between 1728 and 1729. Today the property is owned by Moore's descendant, Louis Moore Bacon under the name of Orton Plantation Holding, LLC.

The current holdings, over 8,500 acres, comprise much of the land along the Cape Fear River north of Sunny Point and about 11 miles south of Wilmington, North Carolina. The cemetery is located about 1,200 feet north of the

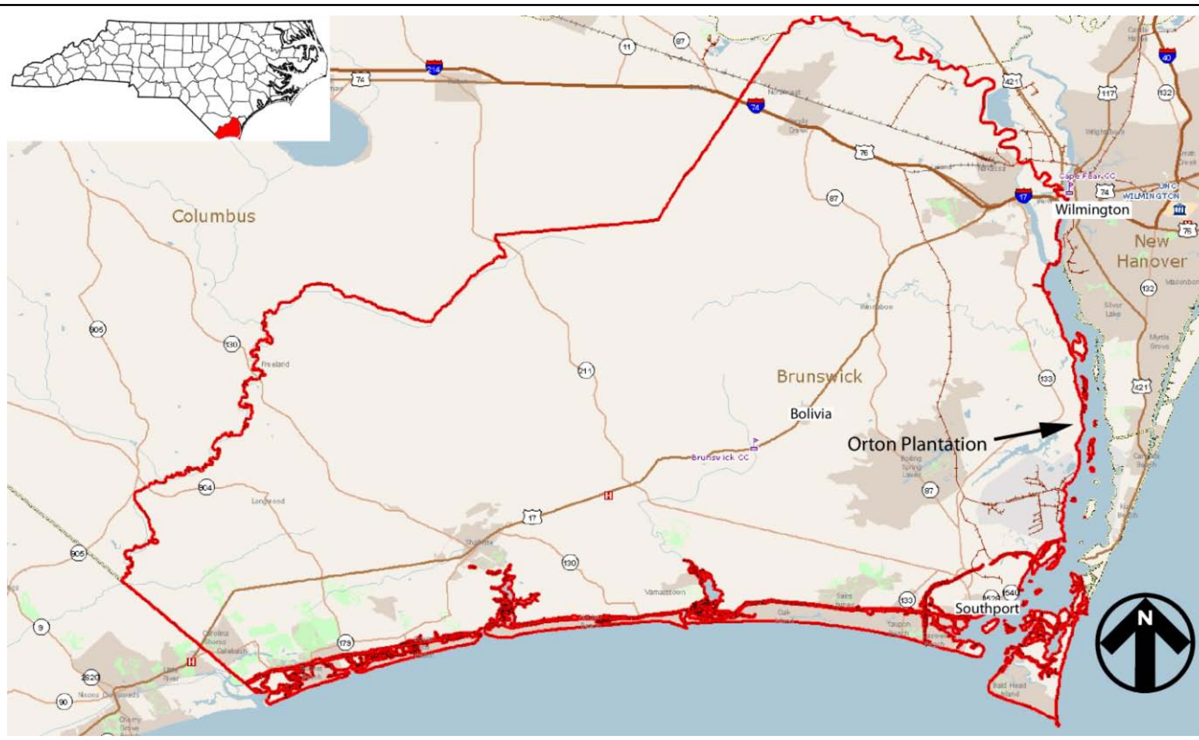


Figure 1. Brunswick County, North Carolina showing the location of the Orton Plantation Cemetery.

Figure 2. View of the Orton Plantation Cemetery looking southwest showing the four brick vaults. To the left side of the photo are an additional four box tombs and one tabletstone.

Orton Plantation house, on a terrace overlooking Liliput Creek to the north and rice fields to the east.

Chicora has previously conducted historic research on the plantation, as well as reconnaissance level archaeological studies (Trinkley and Hacker 2012). As a result of that work, the property owner and descendant of Roger Moore became interested in the cemetery and sought restoration of the monuments, which had fallen into decay. As a result, Chicora Foundation was retained to make repairs, including pointing and repairing partially collapsed tombs.

In order to effectively repair the brick vault roofs it came necessary to gain entry to the tombs. This, in turn required that the remains in the vaults be carefully excavated and cared for, to ensure that they not be damaged by repair efforts.

With the need to collect the remains, Mr. Bacon determined it would be prudent to examine those remains to see if it would be possible to ascertain who was buried in each vault, perhaps confirming or denying family oral history. This work was expanded into conducting genetic analysis of the remains, further refining familial connections. Mr. Bacon saw the work as a unique opportunity to learn about local history and particularly the history of Orton Plantation.

Family and oral history has historically identified the largest of the brick vaults as that of Roger Moore, with the thought that the three small brick vaults might include various wives or children. Since all of the remains, visible in various tomb collapses, were fully skeletonized, successful removal would require bioanthropological efforts conducted by Chicora Foundation. Ultimately the investigations revealed the presence of two females, one 50+ year old male, one teenage male, and five infants. The work also revealed that previous repairs had shifted some of the remains from one vault to another and that the occupant in the largest tomb was a female, not Roger Moore.

The excavations were conducted by Debi Hacker and Michael Trinkley. While Dr. Trinkley directed the excavations and had ultimate responsibility for the research, Ms. Hacker was the project bioanthropologist and was responsible for the exposure and analysis of the remains. Approximately 48 person hours were required for the exposure and excavation of the remains. An additional 160 person hours were devoted to the analysis of the skeletal and archaeological remains.

All of the skeletal and artifactual remains were reinterred in the same vault from which they were removed (with the exception of comingled remains which were returned to their original vault) after the vault repair work was completed.

Field notes, skeletal analysis, photographs, and other records relating to this investigation will be maintained by Chicora Foundation, Inc. Copies were provided to the South Caroliniana Library for permanent curation.

This report includes sections on the genealogy of the Moore family and the history of Orton Plantation to help place the study in a broader historical context. The original investigations by Chicora (Trinkley and Hacker 2012) should be consulted for more detailed information. Also included are sections on the methodology of the exhumation; studies of the human remains, the coffins and associated hardware, and other artifacts present; and finally a discussion of the mortuary behaviors identified at the site and a summary of the investigations.

Project Description

Project Area Description

Orton Plantation is located along the Cape Fear River south of Lilliput Creek. Inland there were historically vast tracts of longleaf pine many of which were at 10 to 20 feet above mean sea level (AMSL). These forests surrounded Orton Pond, which served as a reservoir for the plantation's mills and eventually its rice fields. Between the river and high ground were the rice fields, protected by massive earthen dikes. The main settlement was located on a sandy ridge paralleling these rice fields and rising to an elevation of about 22 feet AMSL. While about 350 feet in width in the vicinity of the main house, this ridge narrows to barely 50 feet at the cemetery, a little over 1,200 feet to the north. Elevations also drop to only about 6 feet AMSL.

Figure 3. Aerial view of the main house and cemetery at Orton Plantation.

Site Description

The cemetery, identified as archaeological site 31BW787**2, is located at UTM 3772938N 228001E (NAD 27 datum). It is today surrounded by live oaks and a twentieth century azalea garden. It is unlikely that the eighteenth century cemetery received any plantings and the area was probably dominated by mixed pines and live oaks, with an understory of grass.

A ground penetrating radar study was conducted to determine if additional below ground tombs might be present, but none were found.

Thus, the site consists of one gabled brick vault and three domed vaults with end pediments. Also present are three brick box tombs with marble ledgers, one marble box with a marble ledger, and one head and footstone. These tombs and monuments form three lines oriented north-northwest by south-southeast, with each individual tomb or grave oriented west-northwest by east-northeast.

The largest, gabled vault by tradition is ascribed to Roger Moore, with the smaller surrounding vaults assigned to wives and other family members. Precisely when this association was made has not been determined, but it dates to at least the early twentieth century.

All of the brickwork exhibits multiple repair episodes, all using hard Portland cement mortar. Much of the stucco, present on all of the vaults, is today gone, although bits of the underlying scratch coat are still present.

There is roof damage at several of the vaults, although the cemetery's condition is vastly improved since 1917 at which time the gable roof of Vault 1was reported to have fallen in ("Pilgrimage to Old Brunswick," *The Orphans' Friend and Masonic Journal,* Oxford, NC, April 20, 1917). This is verified by a photograph showing the vault with its roof collapsed inward (see Figure 5).

Many of the period photographs show the cemetery completely overtaken by undergrowth, such as the panoramic photo by Louis Moore in the first quarter of the twentieth century. It is likely that the vegetation changed and the tombs were repaired in the late 1930s and early 1940s when the gardens were expanded. At least one additional photo shows the graveyard after this repair effort.

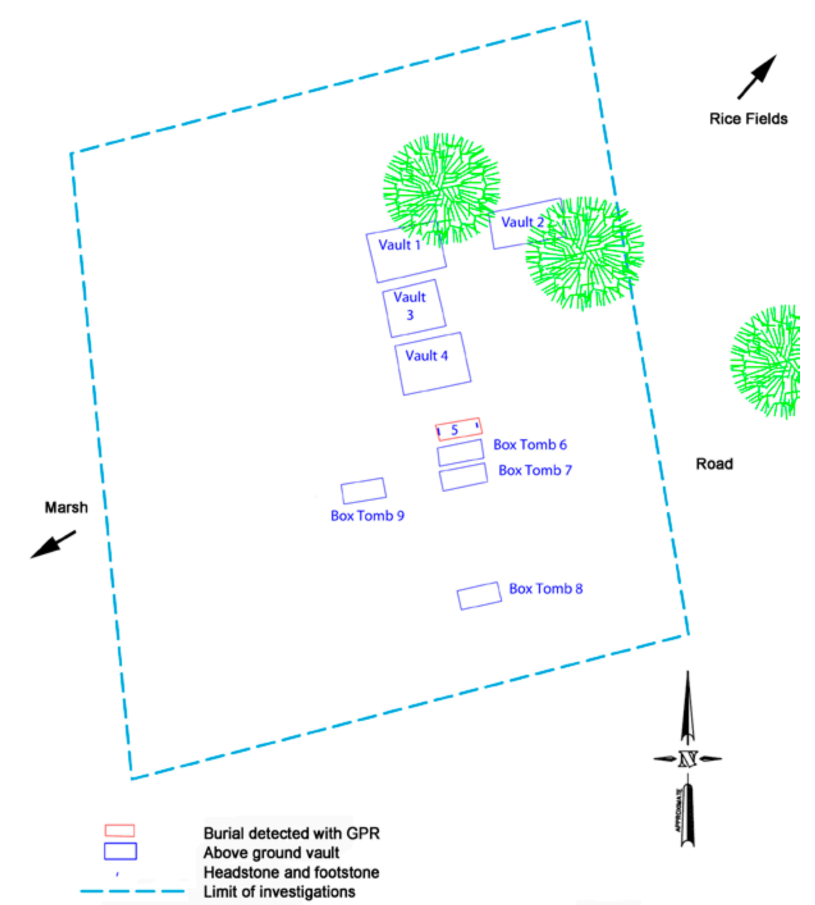


Figure 4. Plan of the Orton Plantation Cemetery.

Figure 5. Views of the Orton Cemetery showing damage to the brick vaults. While neither image is dated, both suggest they were taken in the first quarter of the twentieth century. The upper photo, looking at the rear of the tomb to the east is courtesy of NCDAH, N_73_5_919A Grave of Roger Moore. The lower image, looking from the rear of the cemetery to the north-northeast is courtesy of Nick Dawson, Belvedere Property Management, LLC.

Figure 6. This photograph, likely from the 1930s, shows that collapsed vaults had been repaired and a marble plaque had been mounted on the east façade of the large Vault 1 (far right of this image). Vault 2 is in the foreground and the view is looking west-southwest.

Today the location is well tended and recently much of the modern garden vegetation has been removed.

The box tombs and single tabletstone present at the cemetery are typical of the period. The 1843 ledger of Marie Ivie Winslow is interesting as an example of extralocal stone carving. The four brick vaults are not as common. Table 1 documents the transcriptions from the five stones with extant markers (excluding the marble plaque placed on a brick vault in the early

Table 1.
Inscriptions at Orton Plantation Cemetery

5. In Memory / OF / LOUISA CATHARINE / Eldest daughter of / J.G. & M.A. BURR, / Born Feb'y. 1. 1843 / Died Sept. 6. 1852 / aged 9 yrs. 7 mo's. & 6 dys. / Of Such is the Kingdom of Heaven.

6. MRS. CATHARINE ANN BERRY. / RELICK OF / JAMES A. BERRY. / WAS BORN 3RD OF OCT. 1803. / Died 20th OF AUG. 1844. / Elevated in Sentiments / Ardent and firm in her affections, / Pure generous and disinterested by nature; / the Christian virtues / crowned her with their graves / and as she lived admired, trusted and loved, / so she died lamented / and mourned, / in the blissful hope of glorious / immortality. [footstone: L.C.B.]

7. SACRED / TO THE MEMORY OF / JAMES A. BERRY, / WHO DIED /22^{d} NOVEMBER 1832 / AGED 32 YRS. /BRAVE GENEROUS AND KIND, / HONORABLE AND DEVOUT / A GENTLEMAN AND CHRISTIAN.

8. IN MEMORY OF MARIE IVIE, / WIFE OF / WARREN WINSLOW, / OF FAYETTEVILLE / & DAUGHTER OF JOHN D. TOOMER. / BORN MAY 12, 1811, / DIED MAY 22, 1843. // R.I. BROWN / N.Y.

9. JOHN HILL, M.D. / DIED / MAY 9. / 1847. / AGED 51 yrs.

twentieth century).

Little (1998:45-47) briefly discusses similar brick vaults at other coastal plain graveyards in the context of "vernacular" markers. While these brick vaults may be considered local, they extend southward through South Carolina and throughout Georgia. Thus, they have a very wide occurrence that may go beyond "local."

Little suggests that these tombs were brought to this country by the wealthy, "no doubt from Great Britain," yet she cites only the presence of similar tombs in Boston and New Orleans (Little 1998:10). Perhaps antecedents can be found in England, although Mytum (2000) provides no meaningful parallel. In spite of their spread across the colonial south, there has never been a detailed study of their origin and only one study of their construction (Trinkley and Hacker 1999).

Research Orientation

Research Design

North Carolina's professional archaeologists, with a very few exceptions, have been far more interested in the excavation and analysis of Native American populations than Euro-American or African American groups. For example, Joffre Coe (1995:265) reports on the 226 burials excavated from Town Creek in Montgomery County, North Carolina along with the additional 297 exposed and recorded, but not excavated. Between just 1972 and 1977, 88 Native American burials were recovered from Sk^{v}1a in Stokes County, North Carolina (Navey 1982:10). Hogue reports on 269 burials from five Piedmont Siouan sites (Hogue 1988).

Inquiries to various bioanthropologists in North Carolina regarding analysis of colonial or antebellum burials produced no comparable studies. This is not especially surprising since very few historic burials from adjacent South Carolina have received any detailed investigations (Trinkley et al. 2011:4-5).

Most similar are the investigations by Rathbun from the Hutson Crypt in the Circular Congregational Churchyard in Charleston, South Carolina (Ted Rathbun Collection, National Anthropological Archives, Washington, DC), and the work by Rathbun and Scurry (1991) at Bellview Plantation, also in the Charleston area. Both of these studies, however, are from the early nineteenth century. In North Carolina there is the work by Seeman (2011) at the Foscue Plantation vault in Jones County. While incorporating high-status individuals, these burials are also nineteenth century in origin.

Moreover, it is far more common for African American burials to be removed than for Euro-American remains to be excavated. This, of course, is not news to bioanthropologists, who fully recognize that most excavated cemeteries are those of the poor and disenfranchised. Stephen Nawrocki (1995:63) notes that none of these commonly excavated sites "necessarily reflect the biology or material culture of middle- or upper-class communities of European origin." He observes that individuals of "lower socioeconomic status, while perhaps more likely to be completely destroyed, are also more likely to be excavated and studied," meaning that "the well-maintained European cemetery . . . is lost from study." This same view is explained by Seeman, who observes that, "skeletons of eighteenth and early nineteenth century high-status individuals associated with these plantations are the least-studied burials from that time period" (Seeman 2011:1).

Add to this the unfortunate number of burials commercially removed with no opportunity for scientific examination and it becomes clear that an exceptional data source is being lost.

In virtually every case we can think of, the information derived from bioanthropological studies were not available from any other source. The above ground features, such as fencing and markers, provide a cultural context and clues regarding social and religious beliefs.

The analysis of mortuary items (coffin

hardware, for example) and personal remains (such as clothing) contributes to our understanding of social status, ideologies, possible age and sex, as well as temporal dating of burials. The work may also supplement folklore, oral history, and genealogical research.

The analysis of the skeletal remains, including morphological characteristics, discrete traits, dental features, and pathological conditions provides critical data on diet, disease, mortality, and health.

There are other studies that can address a range of questions. Many of these techniques are destructive and costly. Parasite analysis requires the use of soil collected from the grave that is treated in an effort to rehydrate the ova of any parasites that were present in the lower intestines, such as hookworm, echinococcus, and tapeworm. Blood grouping, HLA typing, and antibody absorption require the use of a vertebra. Contamination remains a significant problem and the benefit depends on specific genetic questions. Histomorthometrics requires the sectioning of long bones to count osteons for aging. Carbon isotope analysis may be able to ascertain differences in diet, although interpretation of results can be difficult if humans ate animals that grazed on plants (a typical scenario). Trace element analysis may also address dietary questions, with zinc, copper, molybdenum, and selenium usually associated with animal protein and strontium, magnesium, manganese, cobalt, and nickel generally associated with vegetable materials. Most studies focus on the level of strontium to calcium ratio. Heavy metals analysis, often focusing on lead, can be examined to explore health and sources of contamination in the diet. Nevertheless, both modern contamination and diagenetic effects must be considered when interpreting results. Finally, radiographic studies can identify transverse lines of increased density on the ribs, on both ends of the tibia and on the distal end of the femur to study dietary stress.

The research design for the remains from the Orton vaults was focused on discerning taphonomic processes, dietary reconstruction, and the quality of life. In addition, the client's primary concern was to determine if these individuals included Roger Moore. To achieve these goals a variety of specific bioanthropological analyses were proposed:

- Mortality – age and sex of the burials

- Quality of life – examination of age-specific pathologies, degenerative joint disease indicators, frequency of trauma, data relating to infections, and the collection of childhood stress indicators.

- Dietary Reconstruction – examination of dental wear, caries frequency, presence of porotic hyperostosis/cribra orbitalia, and incidence and location of calculus. We also incorporated isotope ratio studies for several individuals.

- Population Affiliation – collection of metric and non-metric data when possible to facilitate comparison of these remains with other relevant skeletal populations.

- Taphonomy – examination of movement of remains within the coffin and the vault.

- Burial Patterns – examination of how the burial findings reflect cultural, regional, and environmental use.

- Soil Analysis – examination of macronutrients to determine if any recognizable chemical profiles could be identified. Several burials were also examined for arsenic and mercury levels in the soils.

- Parasite analysis – one soil sample from the pelvic region was examined for evidence of parasites and pollen as a contributor to health and diet.

- DNA Testing – analysis of remains from all of the vaults for mitochondrial DNA (mtDNA), as well as analysis of the remains from a single vault for Y-chromosome DNA. Infants were also examined for the presence of XY or YY chromosomes to allow sexing.

Ethical Issues

Bioanthropological studies in the post-NAGPRA (Native American Graves Protection and Repatriation Act, Public Law 101-601, 1990) era have become more ethical and fair to the deceased and their families than they were in the past – at least if they are Native American. This is because NAGPRA requires the same consultation process for the relocation of historic cemeteries as it does for the exhumation and analysis of ancient human remains.

The disturbance of human remains is usually as agonizing for African or Euro-Americans as it is for Native Americans. Yet, there is no such law or provision for burials of either African Americans or Euro-Americans. Consequently, there is still a long way to go in creating equity between the legitimate interests of descendents and the scholarly interest of archaeologists – and the public that certainly has a right to understand their collective past.

While NAGPRA does not apply to the vast majority of burial or cemetery relocations, the Vermillion Accord on Human Remains and the Tamaki Makau-rau Accord on the Display of Human Remains and Sacred Objects do.

The Vermillion Accord, adopted by the World Archaeological Congress in 1989 recognizes the respect due to human remains, as well as the legitimacy of scientific research. It also requires that agreement concerning the disposition of human remains be achieved through negotiation based on mutual respect, balancing the legitimate concerns of descendents with the legitimate concerns of science and education.

The Tamaki Makau-rau Accord, adopted by the World Archaeological Congress in 2006, stipulates that permission should be obtained from the affected community prior to the display of human remains.

The American Society of Physical Anthropologists has a Code of Ethics last modified in 2009 that integrates many of these principles. For example, the Code of Ethics stipulates that researchers have a primary ethical obligation to those that they study and this obligation supersedes the goal of seeking new knowledge. It mandates that researchers "must do everything in their power" to ensure that their research does not harm the dignity or privacy of those being studied and that the researcher obtain informed consent for the research undertaken.

In compliance with these codes and recommendations, we have obtained consent from the property owner and family descendant, Mr. Louis Moore Bacon, for the excavation, cleaning, and analysis of the remains, the destructive analysis of very small portions of the bones, as well as for the publication of the findings, including photographic documentation pertinent to the discussions. All remains have since been reinterred to maintain their dignity.

Changing Views of Death

When colonial views of death are discussed attention is often directed to the Puritan view that death was a grim and terrifying reality. Historical statistics reveal that this view was well founded – 40% of the children failed to reach the age of 30. But there was considerable tension in Puritan views for while they recognized that death was a release from the pain of this life and a promise of everlasting life, they also realized that death was God's punishment for sin and it presented the possibility of eternal damnation.

In fact, Puritan theology denied any certainty of salvation. God had already determined the fate of each man, woman, and child at their creation and His will was inscrutable. Sins were not forgiven. Given that the fate of a dying Puritan was predetermined, there was no effort to intercede in their behalf and there were no elaborate rites or ceremonies. In an effort to avoid "graven images" the earliest Puritan monuments were simple and included no graphics (Ferrell 1980:18-23; Stannard 1977).

The Puritan view of death began to soften after 1650 and by the early eighteenth century, when the Great Awakening swept through the colonies, views were far different. Death was no longer feared, but was increasingly viewed as an opportunity to reunite with loved ones that had gone before. Adults were more likely to believe that active piety would assure salvation.

Southern colonies, such as South Carolina and North Carolina, were being settled during this period of religious revival. Eighteenth century Anglicanism was characterized by reason, simple devotional activities, and moral living. In fact, Baird observes that:

> If the religion of the one [New England Puritans] was strict, serious, in the regard of its enemies unfriendly to innocent amusements, and even morose, the other [Southern Anglicism] was the religion of the court, and of fashionable life, and did not require so uncompromising a resistance "to the lust of the flesh, the lust of the eyes, and the pride of life" (Baird 1845:60).

Although the Church of England was clearly recognized in the Carolina charters of 1663 and 1665, as well as by various documents prepared by the Lords Proprietors, it held very little influence over the people initially. By the eighteenth century, however, one of the Lords Proprietors, Lord Granville, instructed Nathaniel Moore (son of Governor James Moore of South Carolina and brother of Roger Moore) to ensure the establishment of Church of England in North Carolina by law (Baird 1845:90; Wheeler 1964:34).

Thus, in 1701 the "Vestry Act" was passed, establishing vestries and adding a poll tax on all tithables for the support of the clergy. In 1703 another act was passed, requiring all members of the Assembly to be communicants of the Church of England and to take an oath to Queen Anne. In 1704 the North Carolina General Assembly passed a law establishing the religion of the Church of England in the colony by legal authority (Powell 1989:74).

The victories for the Church, however, were short lived. The House of Lords, upon hearing of the law, declared the "acts were repugnant to the laws of England, contrary to the charter of the proprietors; an encouragement to atheism; detrimental to trade; and tended to the depopulation and ruin of the province" (Wheeler 1964:35). Quakers and Presbyterians joined forces and the various laws were repealed or diluted.

While the politicians fought over religion, the clergy were universally dismayed by what they found along coastal North Carolina. In the Albemarle Sound region one Anglican missionary found the colonists could be placed in four groups.

Most numerous were Quakers, whom he regarded as "enemies of the Church." Another Anglican missionary in the Perquimans Precinct described Quakers as "extremely ignorant, insufferably proud, and consequently ungovernable."

The next largest group had no religion, but might have been Quakers "if they were able to behave themselves." The third group was "somewhat like Presbyterians, which sort is upheld by some idle fellows who have left their lawful employment, and preach and baptize through the country, without any manner of orders from any sect or pretended Church." In today's world, these would be considered Baptists.

The final group, incidentally also the smallest, were "the better sort of people, and would do very much for the settlement of the Church government there" (quoted in Powell 1989:73).

Wheeler (1964:34) presents a similar picture, although he suggests the majority of

North Carolina colonists had no religion at all. A 1704 Anglican minister remarked that not only was the population scattered, but most were "backward in religious matters and little disposed to assist in the support of a minister of the Church of England" (Latham 2012:2).

An interesting statistical view of North Carolina is available for the period of the American Revolution. Stark and Finke (1988) report that in 1776 North Carolina had 165 churches, with a white membership rate of about 8%, seeming to confirm that most North Carolinians had little interest in religion. Anglicans comprised about 14.5% of those claiming a church membership; far more popular were the Presbyterians (28.5%), Baptists (25.5%), and Quakers (18.2%) (Stark and Finke 1988:47).

The Assembly continued to pass laws supportive of the Church of England, in 1741 requiring that freeholders of every parish meet on Easter Monday to choose vestrymen responsible for collecting a tax for building churches, buying glebes, and maintaining the clergy. While some colonial North Carolina governors sought to moderate religious issues, even they were unable to divorce themselves from Anglicanism. For example, Governor Tryon, meeting the Assembly in Wilmington in 1765, opposed religious intolerance, but continued to recommend supporting the Church from the public treasury (Wheeler 1965:50). Perhaps as evidence of a lack of popular support, of the 32 North Carolina parishes in 1765, only five had a church and a minister (Latham 2012:2).

Meanwhile, other religions were growing. Additional Quakers arrived from Pennsylvania by 1740. Scottish Highlanders and Scots-Irish contributed to the growth of the Presbyterian Church. By 1755 there were 16 congregations of Baptists in North Carolina claiming a membership of several thousand. There were also Germans establishing Reformed and Lutheran churches. Their power was greater than their numbers; since their creeds were very similar, many intermarried and moved freely from one church to another (Powell 1989:122-125).

In spite of the growth of other religions, Anglicans such as Charles Woodmason strongly criticized the "New Lights" or those that believed Christians should have emotional and personal conversions (often Baptists and other evangelicals), claiming they had "infested" North Carolina (Hooker 1953).

Unitarianism and Romanticism both arose as reactions not only to Puritanism, but also Anglicanism. It was Evangelicalism, however, that dramatically changed religion and the American view of death.

Evangelicalism arose in eighteenth century in part as a reaction against the lack of spiritual fervor and enthusiasm. Ferrell also notes that it was a reaction "to the irreligion of the Enlightenment and as a response to the material preoccupations of the frontier experience" (Ferrell 1980:35). Evangelicals emphasized the importance of scripture and a conversion experience. God was viewed as a persuasive force and viewed sin as voluntary, not innate. People were free, not predestined.

Going into the nineteenth century Ferrell comments on the rapid rise of Methodism. While Congregationalists, Presbyterians, and Anglicans claimed the bulk of church membership at the time of the American Revolution, the Baptists had surpassed the Congregationalists by 1800 and the Methodists were close behind. By 1850, the Methodists' 20,000 churches made them the dominant religious force in America (Ferrell 1980:36).

The Anglican Church, seen by many as an agency of the British government, was widely abandoned during the American Revolution. It wasn't until 1817 that the Episcopal church organized in North Carolina as the successor to the Church of England.

In America, the "beautification of death" movement began in the late eighteenth century and dominated the nineteenth century. Spurred by Romanticism, the movement was a way to cope with the reality of death. Major features of the movement included elaborate mourning rituals and funerary practices, rural cemeteries with their natural and park-like landscaping, and elaborate memorials. The movement was tied to the wide availability of burial receptacles and decorative hardware, as well as embalming (Laderman 1996:55-58; LeeDecker 2009).

Places of Burial

There was no precedent in British Protestant tradition for the family burial ground. Western European tradition dictated that the dead be buried in churchyard burial grounds and even there some locations were preferred over others. This practice tended to be followed by the Puritans who buried around the meeting house. Virtually every New England town had one or more town burial grounds, whether associated with a meeting house or not.

Southerners, too, had churchyard burial grounds, especially in the larger cities such as Charleston, Savannah, Brunswick, and Wilmington. But even in such locations family burial grounds were not uncommon since travel even a few miles could be arduous. The more dispersed the settlement pattern the more likely that family burial plots would be used. In 1724, This practice was echoed in historic accounts, such as the one by Hugh Jones from Virginia in 1724,

> The Parishes being of great Extent (some sixty Miles long and upwards) many dead Corpses cannot be conveyed to the Church to be buried: so that it is customary to bury in Gardens or Orchards, where whole Families lie interred together . . . . Hence likewise arises the Occasion of preaching Funeral Sermons in Houses (cited in Tate 1956:1).

Sloane observes that, "the lack of clergy and churches led settlers to make the funeral a community affair, symbolic of the settlement's continuation despite the individual's death" (Sloane 1991:17). The symbolism may also have been used by family itself, denoting the continuation of the family in spite of the loss of a family member. Mytum (2004:43) notes that these rural farmstead burials continued even in long-settled regions, although he offers no explanation for the phenomenon. Crissman (1994:10-13) observes that familism was especially visible in Appalachia.

It seems that planters made a conscious decision to bury, and be buried in a plot on the plantation. Evidence of this can be found in Virginia, North Carolina, South Carolina, and Georgia, where burial grounds were often set out in wills and reserved in deeds. It seems that these family cemeteries were laid out with the expectation that the property would remain in the family, descending from one generation to the next.

Often, although not always, these burial grounds were located to overlook what made the planter's fortune, whether it was fertile interior bottoms or rice fields along the Carolina coast.

This may explain the prevalence of family burying grounds throughout the South where families and their importance can be seen at virtually every historical turn, but it is important to observe that similar burial grounds are also found in the northeast (see, for example, Weeden 1910:35-36).

Eighteenth Century Coffins and Hardware

Exploring post-medieval burial practices was described by Chris King and Duncan Sayer as, "a complex topic that must incorporate many different elements of communal and personal life, such as religious denomination, group, familial and household identities, gender, lifecycle, social rank, and wealth" (King and Sayer 2011:11). Thus, while we seek to develop a broad context for Orton in these discussions, it is likely that many factors cannot be fully ascertained.

We can look to Great Britain for antecedents that might have been brought to

North Carolina by individuals such as Roger Moore. Indeed, burial practices in Great Britain changed slowly from the fifth through eighteenth centuries.

Early burials did not make use of coffins. Bishop Richard Cox (1550-1581) reminded his audiences that the Book of Common Prayer does not mention the coffin, anticipating uncoffined burials. The burial ceremony reads in part, “the earth shall be cast upon the body.” Wheatly (1710) also expected burials to lack coffins, writing, "When the body is stripped of all but its grave-clothes, and is going to be put into the grave. . . . ."

These early burials were in linen shrouds, but by 1666 an Act, intended to help the paper trade, required that only wool be used in shrouds. The law was credited with saving at least 200,000 pounds of rag from the grave; nevertheless, it was frequently evaded and changes were made in 1678 and again in 1680 in an effort to enforce its provisions. The Act was eventually repealed during the reign of George III, in 1814. Linen was, however, used for North American burial shrouds during the eighteenth century as documented by King and Ubelaker (1996:39).

While it often assumed individuals using a shroud were unclothed, Litten (1992:76) notes that by the first quarter of the seventeenth century, the body was often dressed in a shirt and cap under the shroud. Moreover, there is compelling evidence that “shroud pins” were actually used to attach face or chin cloths (Riordan 2009:89). The shrouds themselves were closed by tying with strips of fabric.

“Chested” burials – or those using some form of coffin – were allowed only by those of great wealth or social standing. When used for the poor, it was intended only a mode of conveyance, with the body removed from the coffin at the graveside (Puckle 1926). Riordan (2009) suggests that the use of coffins increased during the Queen Elizabeth (1558-1603; Litten 1992:12) and by the early 1600s had become relatively common in Great Britain. Brent Tharp believes that the rise of coffins is associated with the cultural system of Christianity,

> body and soul would eventually be reunified through the Resurrection; the funeral service addressed the preservation of the soul, and burial in a coffin promised better preservation of the body than a winding sheet (Tharp 2003:120).

He further suggests that this process was aided by the increasingly secularization of death, including the efforts by Protestants to eliminate much of the pageantry associated with burial in the Catholic Church.

This increase in coffin use seems consistent with the American colonies as well. Historian Clare Gittings (1984:235-241) examined probate accounts in three English counties from about 1580 to 1650 and found that coffin use increased from about 22% in the 1580s to almost 90% in the 1640s. A similar study for 10 Maryland Counties cited by Riordan (2009) found that while only 79% estates before 1670 mention coffins, 97% of the accounts dated after 1700 have such an expense.

The presence of probate records, of course, is weighted toward the wealthy and the archaeological literature identified a variety of seventeenth century sites were only shrouds were identified (see, for example King and Ubelaker 1996). Thus, it may be that through much of the seventeenth century the use of coffins was restricted to the more wealthy members of society. This may support the contention by Lang (1984:17) that “consistent coffin use” did not occur until the 1770s.

King and Ubelaker (1996:12) note that most Maryland coffins were wood, usually elm, oak, chestnut, or pine (LeeDecker 1994). They were hexagonal in shape and generally had flat lids, although more elaborate vaulted lids (and even shapes) occurred. For example, Riordan (2009:83) suggests that the hexagonal coffin did not become common until the mid- to late-

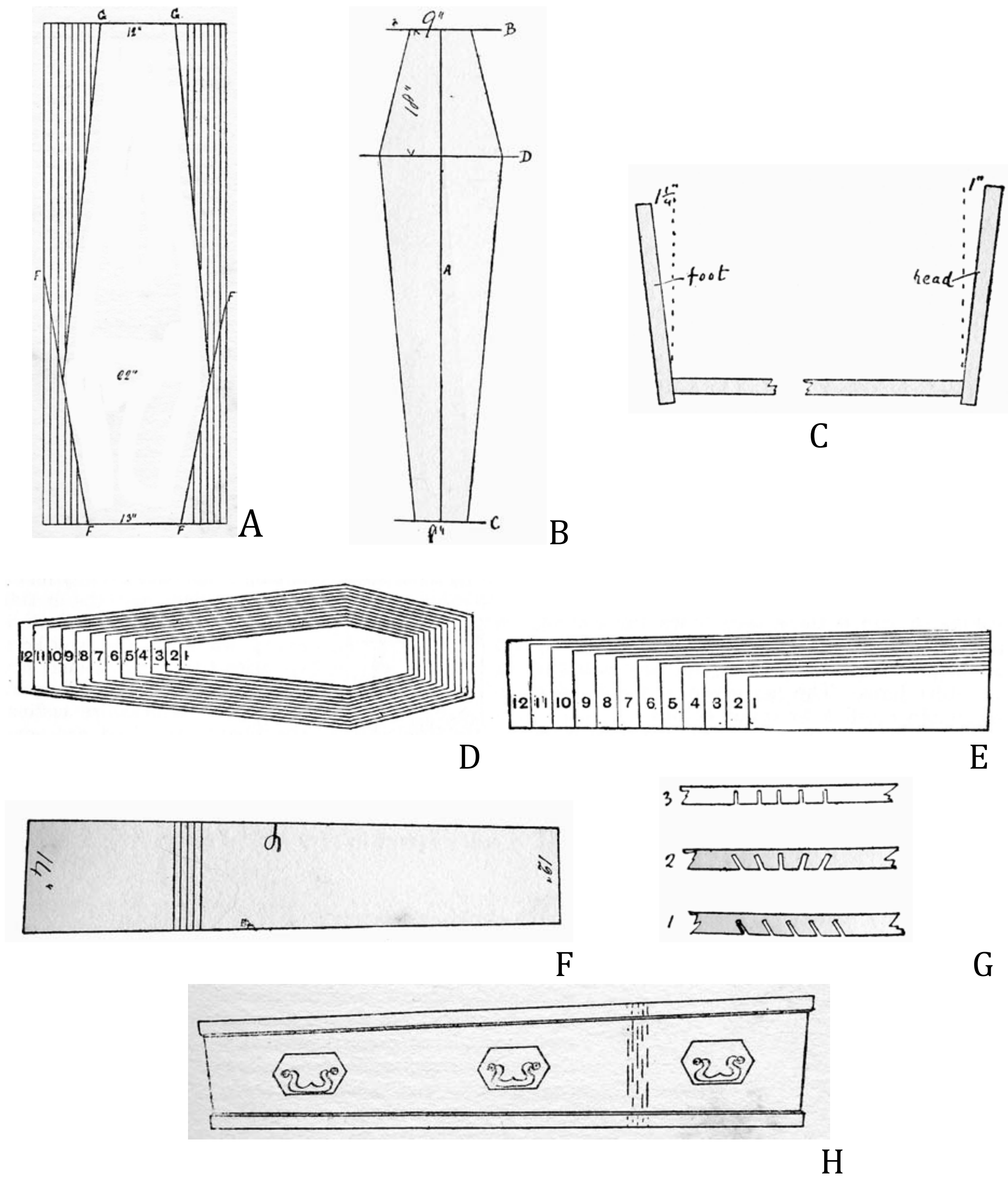


Figure 7. Coffin details. A and B, two different proportions and measurements (Plume 1902:Figures 4, 9); C, longitudinal cross section of coffin (Plume 1902:Figure 11); D and E, scale of coffin bottoms and sides (Hasluck 1905:Figures 5, 6); F, interior coffin side showing kerf cuts to allowing bending (Plume 1902:Figure 12); G, examples of kerf cuts (Plume 1902:Figure 13); H, placement of coffin handles (Plume 1902:Figure 19).

seventeenth century. In contrast, Howson et al 2009:215) contend that the shift to hexagonal, flat topped coffins was "virtually complete," at least in England, by 1725. Noël Hume believes that since "shaped coffins were harder to make than rectangular boxes" the latter were more common, a view that should likely be modified in the face of more recent research. Constructed by the local carpenter or furniture makers, King and Ubelaker again make the point that while affordable to the middling or affluent planter, coffins were likely beyond the reach of the poorer planter in the late seventeenth century.

A brief perusal of Cox (1998) reveals that even into the very early twentieth century most common style produced by English coffin makers was the "toe pincher" and both Plume (1902) and Hasluck (1905) provide easy instructions suggesting that the "shaped coffin" was not as difficult to produce as Noël Hume would have us believe. In fact, Plume describes the "shaped" style as "coffins of the old familiar type, which have obtained probably from time immemorial" going to observe that, "the sharp bend at the shoulders, the tapering sides, and the sloping head and foot, are associated with coffins in nearly every part of the country [Great Britain]" (Plume 1902:71).

As Figure 7 reveals, Plume and Hasluck provide detailed directions for the manufacture of these common coffins.

The eighteenth century coffins were typically "covered with black cloth, the edges of which were embellished with brass nails" (Johnson 2012:12).

Davidson (2004:111) and others suggest that coffin handles were not common until about 1850, corresponding with the advent of mass produced hardware. Certainly many early coffins lacked evidence of hardware, producing only nails archaeologically. Where they occur, however, they are usually described as wrought iron bail handles or plain iron drop style handles by various authors.

Authors provide good descriptions of those found in the New York African Burial Ground (Howson et al. 2009) and at the Kingston-upon Thames Quaker burial ground (Bashford and Sibun 2007).

It appears that many of the coffin handles from the early eighteenth century have been associated with furniture such as sideboards and dressers and not as handles specifically manufactured for coffins. In other words, furniture makers and carpenters used what was on hand.

Howson and her colleagues (2009) suggest that the mass-production of coffin hardware was closely associated with the 1769 patent by John Pickering of London for a stamping process that raised patterns in sheet metal. Prior to this time they claim that coffin hardware was largely made by punching, chasing, and engraving sheet metal. Consequently, the new method reduced the cost of manufacture and made coffin hardware increasingly available to the public.

While the American industry apparently did not begin producing coffin handles until the mid-nineteenth century as previously mentioned, Tharp does note the presence of newspaper advertisements for coffin hardware (such as handled) imported from England as early as 1738 (Tharp 2003:118).

Spatial Arrangement

It is common to report that individuals were aligned with their heads to the west and feet to the east. This orientation is generally associated with Christian beliefs since it allowed the dead to rise up and meet Jesus during the Second Coming as he arrived with the rising sun (Crissman 1994:62, Jordan 1982:30).

Relying on the Judeo-Christian account of Eve created from the left rib of Adam, wives would be buried to the left of their husbands (Jordan 1982:31).

Nevertheless, interments were not always so uniform. Mytum notes that burials were not always oriented east-west in the colonial period, but were at times oriented with other features, such as buildings or fences (Mytum 2004:30).

Organization within the burial ground might also vary from linear rows to nucleated family clusters. While rows in family cemeteries may appear to include unrelated individuals or present no obvious patterning, often genealogical research can identify an implicit order that is not immediately recognizable.

Historical Synopsis

Chicora has produced a relatively detailed examination of Orton Plantation's history (Trinkley and Hacker 2012:13-126) and that study should be examined for a more complete presentation. Here we will only provide a brief outline and genealogy that we hope will add in the understanding of the identified remains.

Roger Moore (1694-1751), born in South Carolina, was the son of James Moore and Margaret Berringer.

His father, James Moore, was an Indian trader and adventurer who emigrated from the Barbados to South Carolina sometime prior to 1675. Beginning as a plantation overseer, he brought 37 servants into the colony with him and by 1683 he obtained a grant in the Goose Creek area for 2,400 acres. He held additional property in Charleston and, in addition to his large plantation, he remained active in mercantile businesses. Within only a few years James Moore was also deeply involved in the colony's political disputes, leading the anti-proprietary Goose Creek faction. He was elected to the First Assembly and his support of proprietary governors put him back in the good graces of the proprietors. He served as the Secretary of the Province, Receiver General, and Chief Justice. He was also named governor of the colony (1700-1703).

He is also known for leading a generally unsuccessful, and very costly, expedition against the Spanish in Florida. Afterwards, his support of the Huguenots in the colony lead to the dissolution of the assembly and riots in Charleston. He was an Anglican, but did not forcefully pursue efforts to establish the Church of England. With Margaret Berringer they had 10 children: James, Jehu (1682-1703), Roger (1694-1750), Maurice (1686-1743), John (1698-1729), Nathaniel (1687-1759), Anne (1697 - ?, m. David Davis), Mary (1680 - ?, m. 1st Robert Howe, 2nd Thomas Clifford), Rebecca (1694-1756, m. 1st Thomas Barker, 2nd William Dry), and Margaret (1682-1741, m. Benjamin Schenckingh) (Edgar and Bailey 1977:466-468).

While Roger's brothers followed their father into the Indian trade, he became a planter in Goose Creek. He was elected as a vestryman, to two Assemblies, and to three Royal Assemblies. Roger Moore is described as "a scion of privilege, with established social, political, and financial status"(Knott et al. 2013:39).

His first marriage, about 1700, was to Mary Rayner, daughter of George Rayner, a Charleston mariner and merchant. They had one son George Moore (1715-1778). Mary Rayner died about 1720 and in October 1721 Moore married Catherine Rhett, the daughter of William Rhett. Rhett was a strong Anglican and was very supportive of the Church in South Carolina. He was also a strong supporter of the proprietors, although he found himself in and out of political trouble his entire career. Nevertheless, although initially supporting his father and brothers in their opposition to the proprietary government, Roger's views moderated after his 1721 marriage to Rhett's daughter.

With Catherine Rhett, Roger had four children: William, Sarah (m. Thomas Smith), Mary (m. Edward Harleston), and Ann (m. 1st John Swann, 2nd Peter Taylor).

When it became impossible to regain control of South Carolina from the King, Roger and other members of the faction began moving to North Carolina. Roger acquired land in the Cape Fear area in March 1726, although acquisitions continued at least into 1729. A series of three deeds create at least 3,000 acres of Orton bordering the Cape Fear and running from Brunswick on the south to Lilliput Creek on the north. Moore was not, however, able to sell his South Carolina holdings until 1731 (Edgar and Bailey 1977:472-473).

Although Knott et al. (2013:40) suggest the Orton house was constructed 1730-1732, there is only circumstantial proof of this dating.

An anonymous author details his June 1734 visit to Roger Moore, "the chief Gentleman in all of *Cape Fear*" (Anonymous 1737:43). At that time Moore was residing in a brick house:

> exceedingly pleasantly situated about two Miles from the Town [of Brunswick], and about a half a Mile from the River; through there is a Creek comes close up to the Door, between two beautiful Meadows about three Miles length. He has a Prospect of the Town of *Brunswick*, and of another beautiful Brick House, a building about half a Mile from him, belonging to *Eleaver Allen*, Esq. [Lilliput Plantation] (Anonymous 1737:43).

The description of the location places the structure at Kendal and suggests that Roger Moore was still living there in 1734.

With the death of his second wife, Catherine Rhett, in 1745, Moore quickly married a third time to Mary Vail Jones Wilson (with reported death dates between 1766 and 1792). Mary came from two previous marriages and is thought to have had her own wealth (Knott 2013:41). This third marriage with Roger resulted in no children.

In March 1747/8 Roger Moore prepared his will, to which a codicil was added in June 1750. By May 1751 Roger Moore had died and his will was proved in the Wilmington Court (Grimes 1912:312). The will provides one of few primary documents providing clear evidence of Moore's plantation activities since there is no surviving inventory of his estate.

At the time Moore wrote his will he possessed "Twenty Odd Thousand Acres of Land & Near Two Hundred & fifty Slaves, with the Stock of Horses, Cattle, &c., & besides the Debts Due To me" (Grimes 1912:311). Moore mentions horses, cattle, and sheep, all at Orton. He also indicates the presence of plate and household furniture, also specifically associated with Orton.

William Moore, Roger Moore's youngest son, was bequeathed "my Plantation Called Orton where I now dwell," amounting to about 2,500 acres. Roger Moore establishes the boundaries as Kendal and southward "on the Creek where My Mill now is." We can suppose that this creek is what is today Orton Pond, but there is no mention of the mill dam or other flood control structures in the will. It sounds as though the mill was situated inland, near the creek, and was not on the Cape Fear.

William was also to receive a fifth of his slaves, divided among his children through "Chance by Lott." William was to receive the horses, cattle, and sheep at Orton, as well as the plate and household furniture. For the bequest, however, William was obligated to pay his elder half-brother George £100. It is interesting that Roger Moore left his primary estate, Orton, to his youngest – not eldest – son. William was, however, the only surviving son from Roger's marriage to Catherine Rhett. Regardless, it appears that Orton remained the Moore's family seat. William was one of the area's largest slave holders with 118 enslaved African Americans according to tax lists (Watson 1996:12).

It has been reported that William was born in 1721, although this seems unlikely since Roger did not marry Catherine until October 1721. Thus, we suppose William was born the following year, 1722.

We know little about William, except that he married Mary Parris Davis (1722-1814) and the couple had at least three children, Edmund

(1740-1785), John (1740-1799), and Roger (1750- ?).

William Moore held Orton Plantation for only a few years. His will, dated November 18, 1754, left his wife, Mary "one half of all my personal Estate, her heirs and assigns forever," as well as "the use of my Plantation at Orton." His estate, however, was bequeathed to his son, Roger Moore (II; 1750-?) (New Hanover County Register of Deeds, Record Book D, pg. 134-135).

Roger Moore at the time was a minor (about 4 years old) and the estate was managed by William's executors, George and Maurice Moore. We know that at least George was not in the immediate vicinity since he had settled a plantation called Moorefield near Rocky Point, about 15 miles northwest of Wilmington (although he also owned neighboring Kendal it is unclear if he used the property for anything other than its forest resources) (Trinkley and Hacker 2012:128).

The estate came with a sizable debt of nearly £1,700 plus annual payments of over £130, suggesting that either William was a poor

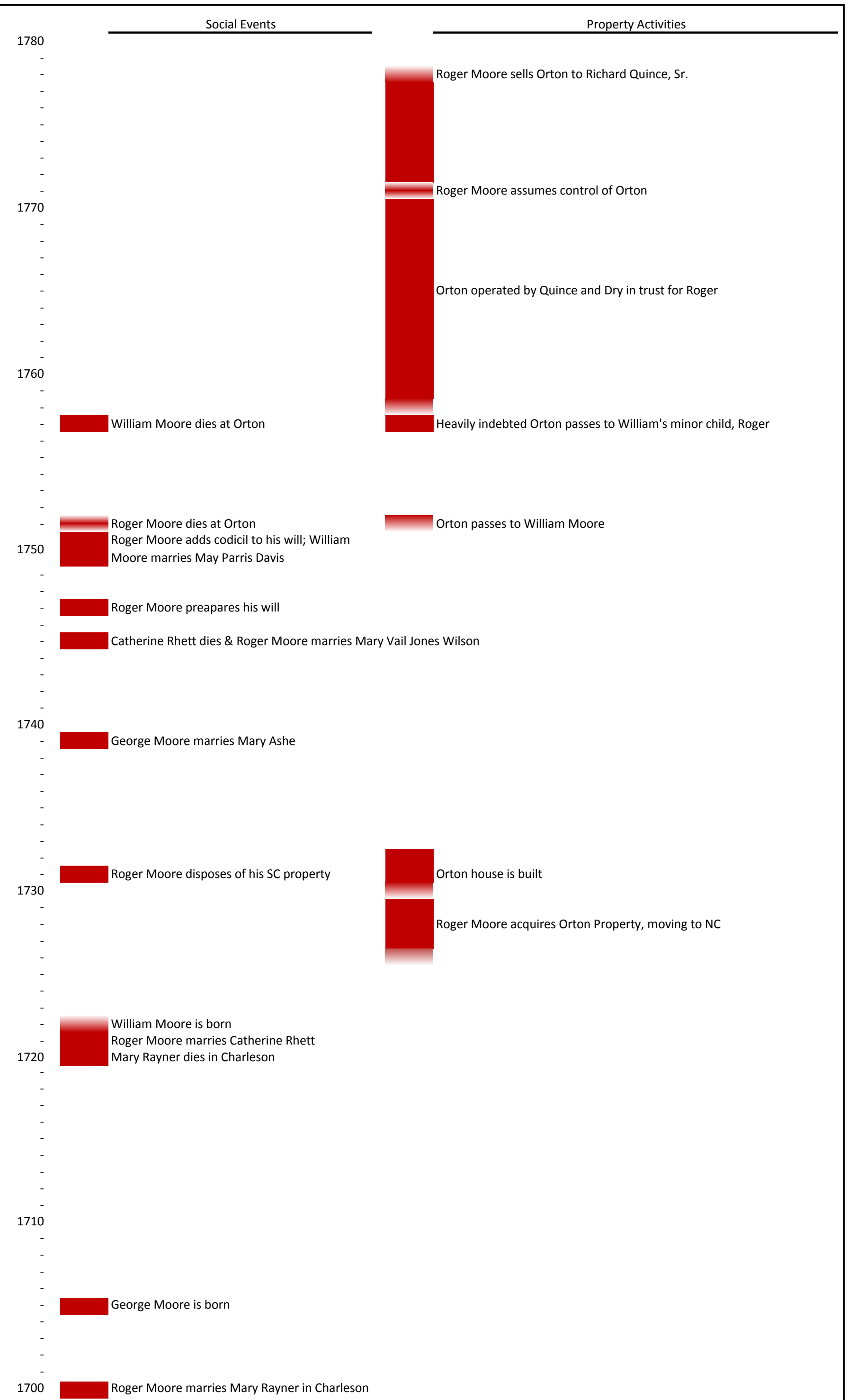


Figure 8. Time line for Orton activities.

businessman or that he had somehow become overextended. While it is possible that Orton was not as profitable as it has historically been assumed, there is really no indication of this debt in Roger Moore's estate.

Regardless, in an effort to resolve the debt and maintain the property in the Moore family, George and Maurice Moore entered into an agreement with Richard Quince and William Dry in 1764. Quince and Dry would repay the debt in exchange for operating the plantation until Roger Moore came of age about 1771 at which time he would own the plantation free of any debt. To ensure the faithful performance George and Maurice held a bond (Brunswick County Register of Deeds, DB A, pg. 1-5).

Both Quince and Dry were wealthy, owning a combined 254 slaves (Brunswick County Tax List, 1769). In addition, both men had marriage ties to the Moore family. Thus, this agreement may have represented a life line to the young Roger Moore and an effort to keep Orton Plantation in the Moore family.

We presume that Quince and Dry surrendered Orton Plantation to Roger Moore when he came of age about 1771 and we know the property was still in the Moore family in 1775 (NC Secretary of State, File 172). Even less is known about Roger Moore than any of the preceding owners and it is even uncertain when he died or if he married.

Through undetermined means Richard Quince the elder acquired Orton Plantation prior to his death in 1778, ending the Moore dynasty at Orton Plantation.

A subsequent deed (Brunswick County Register of Deeds, DB F, pg. 149) traces ownership, noting that Orton was devised "by the late Roger Moore Esquire to his son William Moore by him devised unto his son Roger Moore and by him sold unto Richard Quince grandfather of Richd. Quince aforesaid party."

Figure 8 provides an approximated time line for activities at Orton Plantation. The two most prominent deaths known to have occurred at Orton are those of the plantation's founder, Roger Moore and his wife, Catherine Rhett. We therefore assume at least these two individuals will be present in the plantation cemetery. Others that may be present are more difficult to identify, based on the very limited Moore family history that is available. We unfortunately have no idea which – if any – of Roger Moore's sisters may have made the move with him to Orton. Nor do we have any detailed information on the additional children of Roger Moore and Catherine Rhett.

Burials of Distant Moore Relations

Although we don't have any period descriptions of the Orton cemetery, we can assume that it was maintained during the period of the Moore ownership. With the end of the Moore "dynasty" at Orton the plantation gradually fell into disarray. In 1849 – about three generations later – the cemetery was described as being surrounded by a "wilderness of vines, brush-wood, and reeds, all growing 'in a wild state of nature'." (Wiley 1866:152). Within the cemetery sat "old brick vaults, without a name, and without a date" but "not a shrub, nor a blade of grass" was present and the burials fronted on the "lonely expanse of water."

Nevertheless, as shown in Table 1, there are five burials at the Orton cemetery that appear only distantly related to the Moore family, including Catharine Ann Berry (1803-1844), James Berry (1800-1832), Marie Ivie Winslow (1811-1843), and John Hill (1796-1847), and Louisa Catharine Burr (1843-1852).

At least four of these burials can be explained through descent from Nathaniel Moore (1699-1747), brother of Roger Moore. John Hill, who at the time of his death owned adjacent Kendal, was the great-grandson of Nathaniel Moore. Catherine Ann Hill, wife of James A. Berry, was John Hill's sister and the great-granddaughter of Nathaniel Moore.

James A. Berry was a Wilmington commission merchant who faced sudden and unexpected failure in 1825. By 1828 he had applied to the Court for relief as an Insolvent Debtor and moved from Wilmington to Smithville, where he worked as a clerk for the engineer in charge of public works (Richardson 1845: 114-122, Southern Historical Collection, University of North Carolina at Chapel Hill). Thus, his inclusion at Orton may also have been a charitable act.

Although Louisa C. Burr was the great-great-great-grand- daughter of Nathaniel Moore, kinship seems rather remote and it is uncertain why she would have been buried here as opposed to in Wilmington, where her parents lived. Her father, James G. Burr is shown in the 1840 federal census as having a household of eight free whites and seven enslaved blacks. By the 1850 census, Burr's occupation was listed as a clerk in Wilmington and his family consisted of he and his wife, four children, and one 20 year old female, as well as six African American slaves. Sprunt (2005:247) provides some brief information about Burr, although nothing serves to further explain the burial of Burr's child at Orton.

The last individual is Marie Ivie Winslow, the wife of Warren Winslow of Fayetteville in Cumberland County. Marie Ivie was apparently the great-granddaughter of James Moore (Sprunt 1958:48, White 1996). The 1850 federal census identifies Winslow as a 40 year old Fayetteville attorney with three children between 11 and 14 years old. He owned 5 slaves. He was elected to the North Carolina Senate, briefly served as governor, and eventually served three terms in the U.S. Congress. He was buried in Cross Creek Cemetery in Cumberland County, not with his wife at Orton.

Methods

This section provides information on the general field and laboratory methods followed by Chicora for the excavation of the four vaults at the Orton Plantation Cemetery. Field procedures were intended to ensure the thorough and respectful excavation of all human remains, associated personal items, and coffin furniture that were present. While the work was certainly designed for use in our research on the social and historic contexts of the burials, it was also developed to ensure that the dignity of the remains would be respected at all times.

Field Procedures

Work at the site began with mapping, conducted by GEL Geophysical during the ground penetrating radar investigation of the cemetery, examining an area measuring about 80 feet square. This work used a RAMAC ground penetrating radar (GPR) system configured with 250 MHz and 500 MHz antenna arrays. As a result of the work, no additional burials or evidence of collapsed tombs were encountered.

At each vault the end that exhibited the greatest deterioration of brickwork was chosen for entry. For Vaults 1, 3, and 4, this was the western entrance. For Vault 2, the eastern end was in the most deteriorated condition.

Vaults were opened by using a diamond rotary saw to create center cuts along mortar joints. In some areas an Arbortech brick and mortar saw was also used to facilitate the removal of the mortar joints. In most cases we found three courses of brick with both a high-lime mortar that was likely original to the vaults, as well as multiple repairs using hard Portland cement mortar. In each case it was obvious that the vaults had been entered on several previous occasions and the subsequent repairs used a large quantity of incomplete bricks. While Vault 2 exhibited much damage at the opening, resulting in the brick work being easily removed, the other vaults were much more difficult to penetrate and in each case only enough brick was removed to allow access into the vault, as well eventual replacement of the remains in new caskets.

Excavations

After opening the vaults, work lamps were used to illuminate the interiors. Excavation proceeded from the opening to back wall of the vault to minimize the potential for damage. In only Vault 1 was there any stratification of remains and its presence there was a result of the multiple repair episodes, each of which left a distinct layer of debris. While there was no stratification in Vault 2, the depth of the deposits there was likely the result of multiple episodes of coastal flooding that gained access to the vault, depositing silt debris. Otherwise, human remains were at least partially exposed on the surface.

Excavation was conducted by section of the vault since each vault had low knee walls running across the short dimension (north-south) that served as convenient partitions.

All soil was hand excavated and passed out of the vault in buckets where it was screened through ⅛-inch mesh. Many human remains and some coffin hardware were hand collected from within the vaults. Smaller fragments, including abundant snake and rodent remains, were collected in this screening process. Soil samples were collected for subsequent analysis, primarily for soil chemicals. Only in Vault 4 were the remains undisturbed, allowing for the collection of soil from the thoracic region suitable for parasite analysis.


Figure 9. Opening Vault 3.

Coffin wood (typically identified by shape, placement, or the presence of decorative elements) was saved for analysis and eventual reburial. In addition to coffin wood, there were also some wood remains associated with the building of the vault arches. Because of the twentieth century repair of Vault 1, that tomb produced the largest quantity of wood remains, many of which including wire nails.

The excavator consistently wore a N95 particulate respirator, which filters 95% of airborne particles and nitrile gloves. The screener consistently wore nitrile gloves, often under clean work gloves. Ensuring that human remains were consistently handled with gloves helped guarantee that the remains were not contaminated should DNA analysis be conducted (as it was).

All remains were bagged as either bone or artifacts to prevent damage. Bones were wrapped in clean newsprint to help pad them; in general the remains were in fair to excellent condition.

Brick and mortar rubble were separated and consistently weighted prior to discard. Wood remains were not weighed, but were briefly documented prior to being discarded.

Each vault had all remains removed to expose clean brick floor and walls at which time the vaults were measured and drawn in plan and profile.

Because of concerns regarding the structural condition of Vault 1, it received a detailed examination by a structural engineer after the completion of the excavations. That information is provided in the detailed discussions regarding this vault.

Soil Testing

Embalming began during the Civil War as a means stemming decomposition and allowing safer transportation of bodies. It was far more often used by the North and embalming was not a policy among Southern forces. Chemicals used in these early efforts included arsenic, zinc chloride, bichloride of mercury (also known as corrosive sublimate; today mercuric chloride), aluminum salt (aluminum sulfate), or sugar of lead (lead(II) acetate) (Mayer 1996:440). As basic elements these will not degrade or change, but will either stay with the remains or more commonly move into the environment (Konefes and McGee 1996:16).

Table 2.
Arsenic and Mercury Levels at the Orton Plantation Cemetery

Vault	Arsenic (ppm)	Mercury (ppm)
1	4.0	<0.4
2	3.0	<0.4

There is no reported instance of

Figure 10. Excavation. Upper photo shows excavation in Vault 2 looking to the west. Bottom photo shows excavation in Vault 4 looking east.

embalming efforts during the eighteenth or early nineteenth century, so we had no anticipation of encountering any heavy metals during the removal of burials from the vaults.

Nevertheless, we tested soil samples from within Vaults 1 and 2 to provide comparative data for presumed eighteenth century burials and the results are shown below in Table 2. Levels are very low and appear to represent background environmental levels with no indication of contamination. Thus, as we anticipated, the burials in these vaults were not embalmed.

Of admittedly more use are the general soil analyses conducted of the soil found in each of the vaults. It is probably useful to explain that we believe most of this soil is the result of debris entering the vaults during periods when they were opened for new burials or when the vaults deteriorated and allowed debris to enter. Of course, some also represents decomposition of both human remains and the wood caskets.

While there are some interesting differences, for the most part all of the soils were very similar. Although typical soils in this area are acidic, with pH values ranging from 4.5 to 6.0, those within the vaults were neutral to very slightly basic. This is likely the result of the neutralizing affects of the lime mortar, which was abundant in all of the vaults, as well as the bones themselves, since calcium levels range from just over 7,000 ppm to over 13,000 ppm.

Phosphorus, potassium, and magnesium levels are all high and generally very similar (although some anomalies are found in Vault 4). Phosphates have been routinely linked to occupation areas and the associated

Table 3.
Soil Analysis for Vaults 1-4 at the Orton Plantation Cemetery

	Soil pH	Organic Matter (%)	Phosphorus (ppm)	Potassium (ppm)	Magnesium (ppm)	Calcium (ppm)
Vault 1	7.6	3.1	60	36	160	8284
Vault 2	7.6	3.3	57	35	152	7089
Vault 3	7.7	4.0	60	33	168	7983
Vault 4	7.3	13.7	133	37	294	13504

decomposition of organic materials (Sjöberg 1976, Woods 1977, Holiday and Gartner 2007).

While we can't readily explain the higher levels of organic matter, phosphorus, magnesium, and calcium in Vault 4, these results do provide significant reference samples for the chemistry of soils developed in a vault situation. This topic has received little research and will be of assistance to forensic investigations.

Laboratory Procedures

Cleaning and Processing

Because all of the skeletal and cultural remains are to be reinterred, long-term preservation and curation approaches were unnecessary. It was, however, critical that all remains be treated with dignity and respect throughout the laboratory processing. All remains were stored in a secure, climate-controlled facility.

All human remains were inventoried and then cleaned of adhering soil that could hinder osteological analysis. While remains were in generally good condition, we selected not to wash the remains since chemical studies were anticipated. Thus, while occasionally cleaning was conducted using bamboo splints, soft brushes, or cotton, no water or other chemicals were used.

Other more durable specimens, such as buttons, nails, and coffin hardware were only occasionally cleaned using water. Given the nature of the burials, there was little adhering soil. Coffin wood was lightly brushed to remove adhering soil and permit more detailed analysis. The only fabrics encountered were found as impressions on metals. These were only lightly brushed prior to photography.

The skeletal remains were gradually introduced to the controlled laboratory setting with a relative humidity that was maintained at 50% RH. In some cases this proved to be too dry for the bones and they were placed in partially open polyethylene bags to retard moisture loss.

A few of the metallic specimens were subjected to electrolytic reduction in a bath of sodium carbonate solution in currents no greater than 5 volts for periods of less than 24 hours. Since all materials were being reburied the goal of this was simply to make features more distinct for analysis or photography.

Osteological Methods

Following the recommended procedures in *Standards for Data Collection from Human Skeletal Remains* (Buikstra and Ubelaker 1994), specific data sets were recorded for each individual where preservation allowed. These data included: skeletal and dental inventories; age-at-death estimations; sex assessments; ancestral attribution; presence of pathology; and both metric and non-metric observations. A variety of standard osteological manuals were used (e.g., Bass 1995, Mann and Hunt 2005, Ubelaker 1998, Schwartz 2007, White and Folkens 2000), as well as protocols developed for forensic cases (Rathbun and Buikstra 1984, Steward 1978, Moore-Jansen and Jantz 1986).

The analysis was supplemented with the radiometric documentation of extant long bones and pathological lesions. This information can be useful for age determination, Harris line formation, pathology evaluation, and osteoporosis assessment. For example, Harris or transverse lines of increased density provide information on dietary stress. During periods of illness or malnutrition growth stops. As the problem resolves, growth recovers and there is a line of increased density resulting from osteoblastic activity. Of course, these lines may also occur as a result of lead, bismuth and other heavy metal poisoning.

Bones were placed directly on the x-ray film and the cone was at 40 inches. All radiographs used the anterior-posterior orientation and exposure typically was 10 MAS at 50 kV.

Fabrics

The few items with cloth impressions were examined without magnification, and at 10x, 20x, and 30x under reflected light. More information regarding textile analysis is provided in the section on that analysis. It was not possible to obtain yarn or fabric identifications.

Coffin Wood

Wood samples were broken in half to expose a fresh transverse surface. The samples were then examined under low magnification (3x to 30x) with the fragments identified, where possible, to the genus level using comparative samples, Panshin and de Zeeuw (1970), and Koehler (1917). The wood, like the bone, was in good condition and identifications could readily be made on all studied samples.

Other Cultural Remains

Materials such as nails and buttons were classified using common archaeological guides, such as Noël Hume (1978) and South (1977a). Coffins and associated hardware were identified using common terminology (Trinkley and Hacker 2007) and a number of sources (e.g., Davidson 1999, Lang 1984), as well as a wide variety of catalogs available in the Chicora collection.

Radiocarbon Dating

In an effort to better define construction episodes for the four vaults both coffin wood and skeletal remains were subjected to radiometric dating by Beta Analytic. These remains were not always as useful as hoped since multiple probability ranges appear in some cases, due to short-term variations in the atmospheric ^{14}C contents at certain time periods. Greater discussion is provided on a case-by-case basis.

Stable Isotope Analysis

Bone samples from individuals from Vaults 2, 3, and 4 were submitted for stable isotope analysis by Beta Analytic using bone collagen.

In 1826 Anthelme Brillat-Savarin wrote (translated from French), “Tell me what you eat and I will tell you what you are.” This remains a central theme of dietary analyses using stable isotopes today. Isotopes are forms of the same element that differ in their number of neutrons and consequently have different nuclear masses. For example, ^{12}C, ^{13}C, and ^{14}C. ^{14}C is unstable and thus is useful in radiometric dating. In contrast, ^{12}C and ^{13}C are stable and may be used to reconstruct past diets. Nitrogen isotopes ^{14}N and ^{15}N allow for an improved understanding terrestrial food chains and trophic levels, including the identification of legumes and allowing terrestrial and marine dietary distinctions. When bone collagen is used in analysis, the results largely reflect protein in the average diet during the last several years of life. In contrast, where tooth enamel is used, the results more generally reflect the whole diet during the period of tooth formation.

Best practice involves testing archaeological faunal remains at the same time to help interpret isotope results. Several examples are shown in Figure 11 and while there is an overall similarity in placement, there is considerable local variation. Unfortunately, for this work it was not possible to submit archaeological bone for analysis and these generalized examples – while developed for other regions – were used. Additional research is clearly necessary.

In addition, human diet in the historic period represents a mixture of a variety of sources. The isotopic composition of an individual consumer reflects the composition of the diet, weighted by the proportions of the dietary items. There are several dietary mixing models available

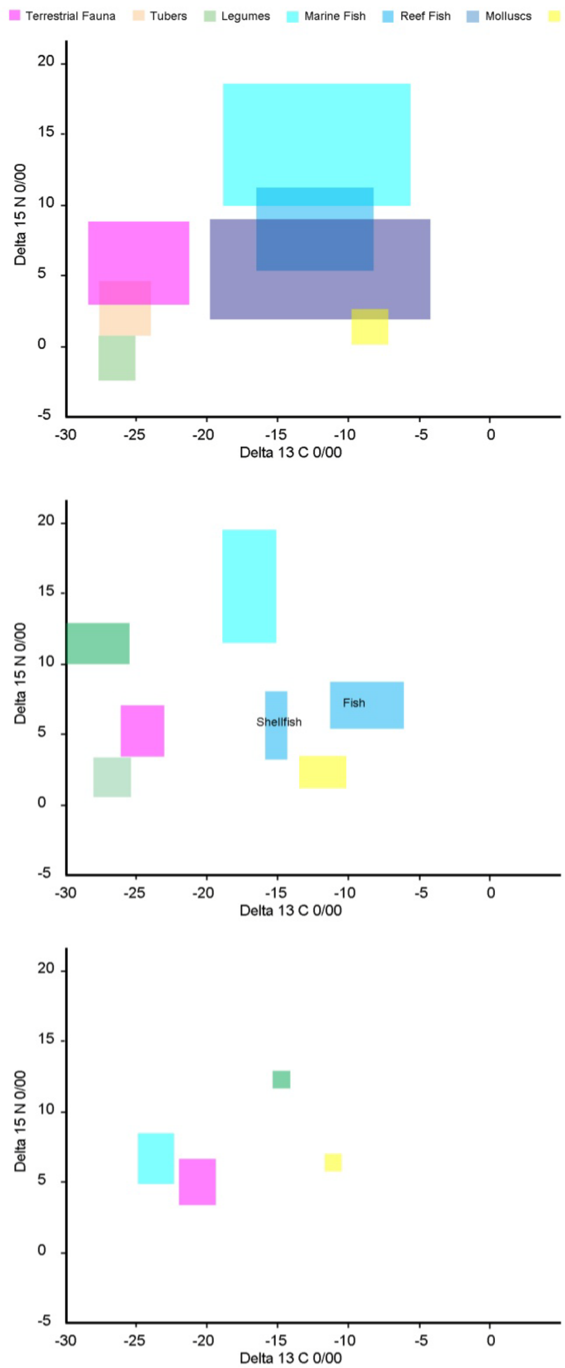


Figure 11. Comparison of three stable carbon versus nitrogen ratios for plant and animal groups. Upper chart is adapted from Norr 1995. The middle chart is adapted from Tykot and represents a Gulf Coast example. The lower chart is from Hogue 2003, 2007.

(e.g., Phillips 2012), although it does not seem that archaeologists have yet sought to explore these possibilities.

Parasite and Pollen Analysis

Preserved paleoparasitological remains may be found in soils under a variety of environmental conditions and may provide considerable information on issues of hygiene, sanitation, and the nutritional status of past populations.

Ascaris (a roundworm) and *Trichuris* (whipworm) are the most commonly identified human parasites and they are both typically found in the same host. Adult *Ascaris* live in the small intestine of the host, while the adult *Trichuris* lives in the colon. Indiscriminate defecation near dwellings or improper disposal of chamber pot wastes will contaminate the soil with eggs. These eggs require a suitable environment to continue development, but *Ascaris* eggs can remain viable for several years. Humans become infected when they ingest the eggs, usually through the hand-to-mouth route.

Typically pollen analysis is used to help reconstruct paleoenvironmental conditions, although it can also contribute to dietary reconstructions.

Because of the chemical composition and structure of parasite eggs their preservation is similar to that of pollen. Thus, not only have the procedures for processing sediment in parasitological studies been largely derived from palynology, but the processing for one does not typically destroy the other.

We felt that for these studies to be useful, it was essential that we found human remains in close to in situ conditions and evidencing little outside contamination. Since most of the vaults had been opened on numerous occasions, either to add more individuals or for repairs, only Vault 4 was thought to contain deposits worthy of these detailed analyses.

These studies were conducted by the PaleoResearch Institute in Golden, Colorado (Cummings and Varney 2014). A chemical extraction technique based on flotation is the standard preparation technique used for the removal of parasites and pollen grains. After extraction of parasites and pollen a light microscope was used to count pollen at a magnification of 500x. Additional details are provided in the following discussions.

Paleo-DNA Studies

Samples of cortical bones and/or teeth from all of the individuals identified in our work were submitted to the Lakehead University Paleo-DNA Laboratory. Although recent research (Nundorff and Davoren 2014) suggests that small cancellous bones, on average, have much higher levels of DNA per unit mass than dense cortical bones, this publication post-dated the initiation of our work. In addition, it seems reasonable to submit those bones with which the testing lab is most familiar.

Initially mitochondrial DNA (mtDNA), the DNA located in mitochondria within eukaryotic cells, was examined. This mtDNA is inherited solely from the mother and therefore provides lineage only to female members of a family. This allows genealogical researchers to trace maternal lineage, as has been done in this study.

In contrast, Y-chromosomal DNA, paternally inherited, is used in an analogous way to determine the patrilineal history. This process was used in the case of the single male recovered from the vaults, comparing his Y-chromosomal DNA with that of a know lineal descendant of Roger Moore.

The standard processing techniques of the Paleo-DNA Laboratory were used. These included surface sterilization with 10% bleach, rinsing with sterile water, and drying with 70% ethanol. Each fragment was then milled into a fine powder. The dried power was demineralized using EDTA. An enzymatic treatment with Proteinase K was used to break up protein compounds associated with the DNA. This was followed by a silica bead purification and additional size exclusion column purification.

Depending on a variety of environmental factors and time, it is possible that only small amounts of intact genetic information will be recovered in archaeological samples and these levels are below the detection threshold of conventional molecular techniques like capillary electrophoresis. Consequently, the next step is a standard Polymerase Chain Reaction (PCR) procedure was then performed to amplify (or multiply) the DNA. Primers specific for the human mtDNA hypervariable regions (HVI base pairs 16024-16365, HV2 base pairs 73-340) were used. This process uses 30 to 50 cycles of heating and cooling, with the number of molecules doubling after each cycle, yielding millions of identical copies carrying the desired information suitable to be read with electrophoretic methods.

The PCR reactions were then run on a 6% Polyacrylamide Gel stained with ethidium bromide for visualization of PCR product. This process of capillary electrophoresis allows the exact measurement of fragment length for kinship analysis as well as direct sequencing of amplified DNA molecules.

The mitochondrial PCR product was next purified with Applied Biosystems recommended purification protocols, direct sequenced with Applied Biosystems Big Dye Terminator Chemistry, and run on the ABI 3130xl Genetic Analyzer.

DNA based kinship analysis within a family group refers to certain structures of genetic information, known as STRs (Short Tandem Repeats). These loci within the genome have no known physiological features – they consist of small DNA "words," tandemly arranged in a varying number of repeats. The number of repeats is specific for each individual and inherited according to Mendel´s laws.

The existing DNA extracts were utilized for the next phase of analysis, Y-chromosome profiling. A standard PCR reaction was performed using the 17 marker Y-Filer kit by Life Technologies. The resulting PCR product was run on the ABI 3130xl Genetic Analyzer.

In order to identify outside contamination, DNA typing was also conducted for the primary individual handling the remains during recovery and analysis, Debi Hacker. As testimony to the care with which excavation and analysis was conducted, no extraneous DNA was identified.

While DNA analysis can offer many contributions, the primary goal of this research was kinship analysis – accessing the kinship between the individuals recovered from these four vaults. Combining this with testing of the Y-chromosomal DNA also contributed to the probable identification of Roger Moore.

Heavy Metal Analysis

There has been extensive research on the skeletal lead burden. The initial research was conducted using graphite furnace atomic absorption spectroscopy (Wittmers et al. 1981) and several subsequent articles (Aufderheide et al. 1981, 1985) used this technique to examine differences in the lead burden of whites and blacks in Colonial America, with the results often associated with variations in social rank.

One of the primary lead contributors is thought to have been pewter vessels, typically owned in great quantities by the wealthy. Colonial pewter contained about 4% lead, which was readily leached out by acidic food. The problem was especially severe in hollow ware (such as tankards, flagons, and porringers). In addition, there were a variety of lead glazed earthenwares used for dairying and storage (Aufderheide et al. 1981:287). In all cases the contributions of soil and ground water must be ruled out.

Rathbun and Scurry (1991) examined the remains of the Edward Croft family from Belleview Plantation in the Charleston, South Carolina vicinity. Results there, and elsewhere, demonstrate that whites typically have significantly higher lead burdens than African Americans.

As it became more difficult to find graphite furnace atomic absorption spectroscopy equipment. Hu et al. (1991) found that K X-ray fluorescence was an accurate proxy. The availability of K-XRF equipment has also become problematic. Consequently, we chose to use inductively coupled plasma mass spectrometry (ICP-MS).

Although we have no African American remains for comparison, it seemed reasonable to examine lead levels in the four adults present at Orton (one each from Vaults 1-4) in order to determine if the observations found elsewhere in South Carolina and the Middle Atlantic colonies held true for this locale as well.

Smith et al. (2013) found that the lead levels in the top 5 cm of soil in North Carolina averages 21ppm, while the average of lead in the A horizon was 20 ppm. To confirm these results, a soil sample from the vicinity of the tombs was submitted to A&L Eastern Labs. The lead levels identified in this soil sample were somewhat lower than the reported averages, only 12 ppm. Lead levels in water are <3ppb (Anonymous 2013). Consequently, water and soil sources can be ruled out for the analysis.

Samples of several bones were submitted to Elemental Analysis, Inc. in Lexington, Kentucky for lead analysis.

Mortar Analysis

Mortar and stucco from several vaults was sampled and submitted to the U.S. Heritage Group in Chicora for detailed chemical and petrographic analysis.

Each sample was analyzed according to chemical procedures and petrographic examination methods of ASTM C1324, "Standard Test Method for Examination and Analysis of Hardened Masonry Mortars".

The mortar was examined using a stereomicroscope up to a magnification of 100X. Portions of the binder portion of the mortar were prepared on glass slides in several refractive index oils in the range of 1.30 to 1.71 and examined for identification using a polarizing (petrographic) microscope up to a magnification of 600X. The optical and morphological properties of the phases present were used to identify the various constituents present, including primary and secondary calcium carbonate, hydrated lime, gypsum, brucite, free lime, cement (if present), and any other substances.

The chemical analysis was conducted, using wet chemical procedures in ASTM C1324 and Scanning Electron Microscopy (SEM-EDX), X-ray fluorescence spectroscopy (XRF), X-ray Diffraction (XRD) and Thermal Analysis.

Disposition

At the conclusion of the study all materials were place in Wilbert Loved and Cherished® 31-inch Baby Burial Vault/Casket Combos. These were sealed and replaced in their respective vaults at Orton; set on the knee walls to ensure air movement and prevent the remains from sitting in water should the vaults flood at some future time. The use of these caskets should ensure long-term preservation of the remains, allowing them to be accessed in the future should additional studies be warranted or desired by the family.

Field records will be curated by Chicora Foundation for the immediate future until such time as Belvedere Property Management authorizes permanent curation at the South Caroliniana Library at the University of South Carolina.

Vault 1

Vault 1 is situated in the northwest corner of the cemetery, immediately north of Vault 3 and inland (or west) of Vault 2. It is certainly the most impressive of the vaults, having not only a larger footprint, but also being the only vault at the cemetery with a tall gable roof and gable pediments. It has been ascribed as the last resting place of Roger Moore, even having a marble plaque attached to the vault in the mid-twentieth century making that claim. The reasoning behind this attribution is almost certainly that it is the most impressive and it was assumed that the most impressive must be that of the fabled "king."

Our study revealed that while several individuals had been moved into the vault during repairs of Vault 3, the only original occupant was a female, interpreted as a probable sister of Roger Moore.

There is little institutional history associated with the vault beyond a series of photographs (see Figures 5 and 6). By the late antebellum the cemetery had already begun to grown up and was fully overgrown by the early twentieth century. By 1917 the roof of Vault 1 had collapsed. By ca. 1930 it had been repaired and the marble plaque added. There are numerous repair episodes using hard Portland cement mortar, so it is likely that each generation used the techniques available to them in an effort to "preserve" this tomb.

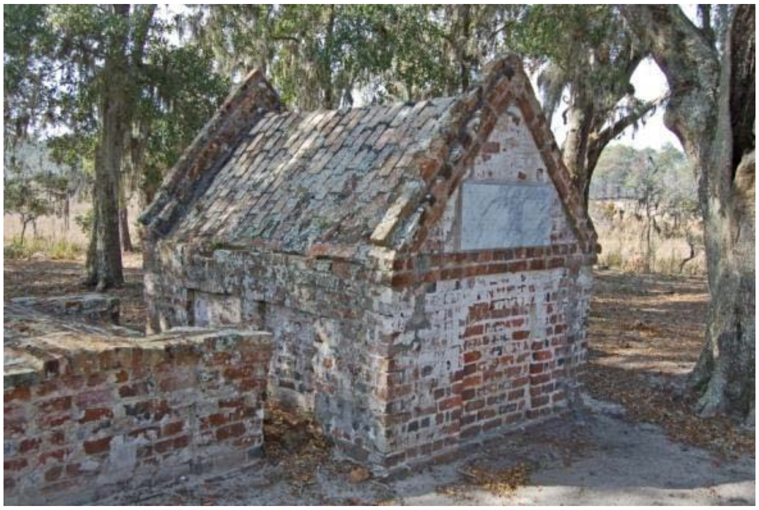


Figure 12. Vault 1. Upper photo shows the vault looking to the northwest. To the left is Vault 3. Lower photo shows a mid-twentieth century marble plaque promoting the tomb as that of Roger Moore.

Additional information concerning these repairs will be discussed in this section, but during our work it became obvious that there were at least two repair episodes (probably more) and we determined that prior to any additional repairs, it was appropriate to have the vault assessed by a structural engineer.

Structural Analysis

Description

The structural analysis was conducted in December 2013 by Ms. Sarah Towles, P.E., with Stroud, Pence & Associates of Raleigh, North Carolina (Towles 2014). These discussions are abstracted from that study.

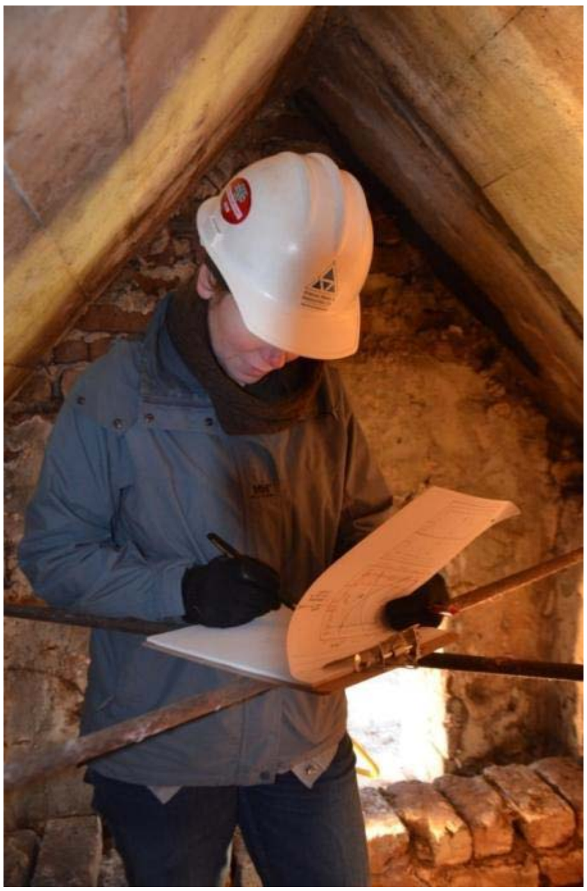


Figure 13. Structural analysis of Vault 1 in December 2013.

The current Moore Vault consists of unreinforced brick masonry side and end walls and a gabled roof of brick masonry on a cement slab. The overall exterior plan dimensions are 7 feet wide by 10 feet long with side wall heights of 3.5 feet and a ridge height of 7 feet. The roof slope is steep at 1:1 or 45°. The size of the historic bricks varies but averages approximately 4-inches wide by 9-inches long by 3-inches tall.

The long north and south side walls are three brick wythes thick (about 12-inches) at their thickest points. Both walls also have two half-wythe recesses. The shorter east and west gable end walls are also three wythes thick at the lower portion and two wythes (about 8-inches) thick at the upper triangular portion. The interior plan dimensions therefore are 8 feet long by 5 feet wide. At the time of the inspection, the structure had been breached at the west end wall. The floor is also brick masonry, and three 20-inch-high knee walls running north-south divide the interior into four approximately equal spaces.

The north and south side walls are tied together with two ¾" diameter steel rods which cross at the center of the space. The anchorages of these tie rods are located at approximately third points along the walls in plan. While the extent and exact anchorage of these tie rods is not visible, we expect that these rods have short hooks and terminate in the excess Portland cement that has been poured on top of the interior shelf of the side walls.

We assume that the existing roof was likely reconstructed such that it maintained the same shape and exterior appearance as the original construction; however, the methods and materials used to achieve this differ from those used originally. The existing gable roof consists of historic bricks on a Portland cement slab reinforced with chicken wire mesh.

The cement slab was poured on wood formwork supported on a wood substructure, both of which disintegrated over time. The 1x8 formwork typically spanned in the long direction from end wall to end wall; however, at the northwest corner of the roof, the formwork changed direction to span in the short direction from top of side wall to ridge. It is not clear why

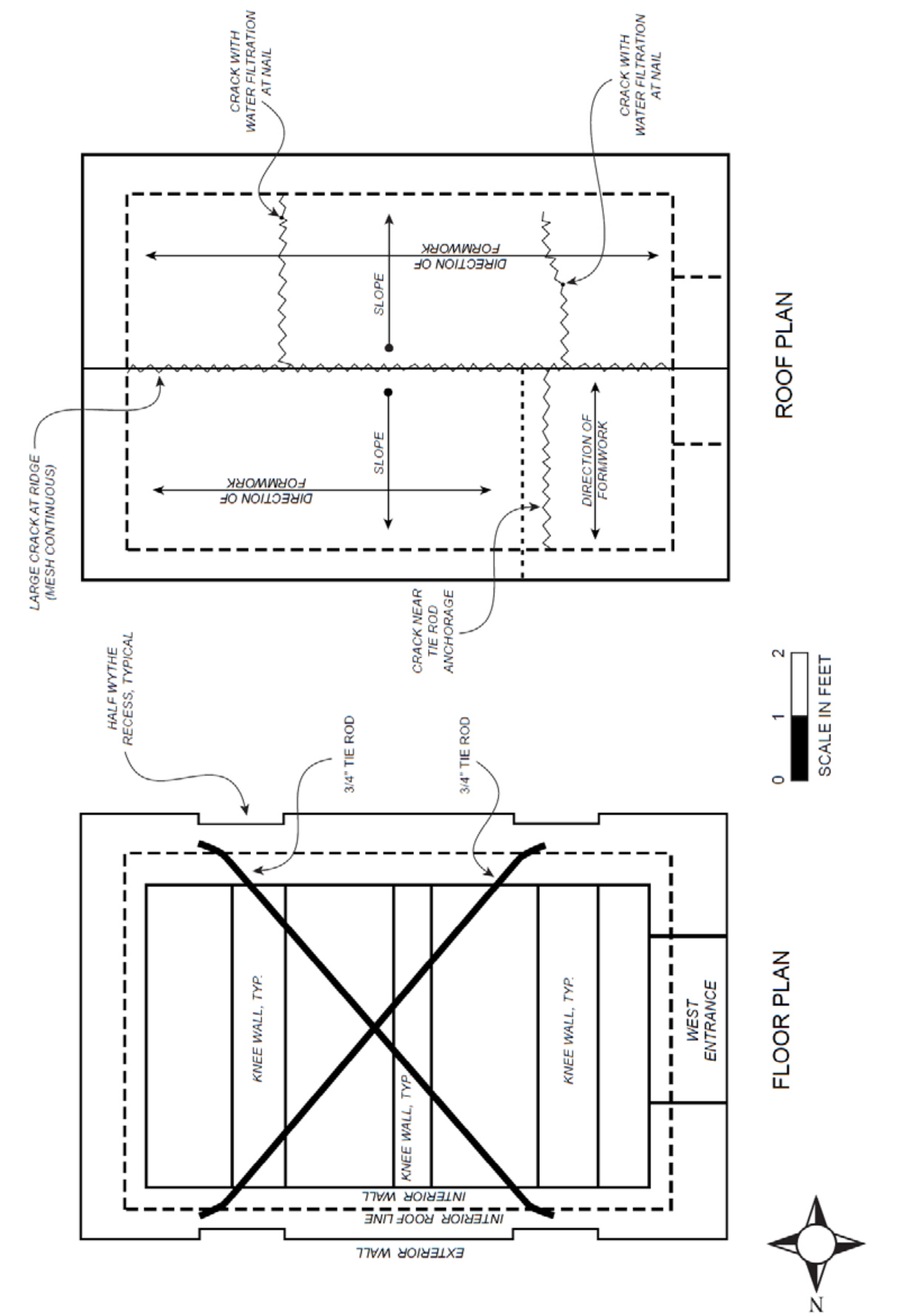


Figure 14. Vault 1 plans. Drawing on the left is the floor plan. Drawing on the right is interior roof plan (drawings adapted from Towles 2014).

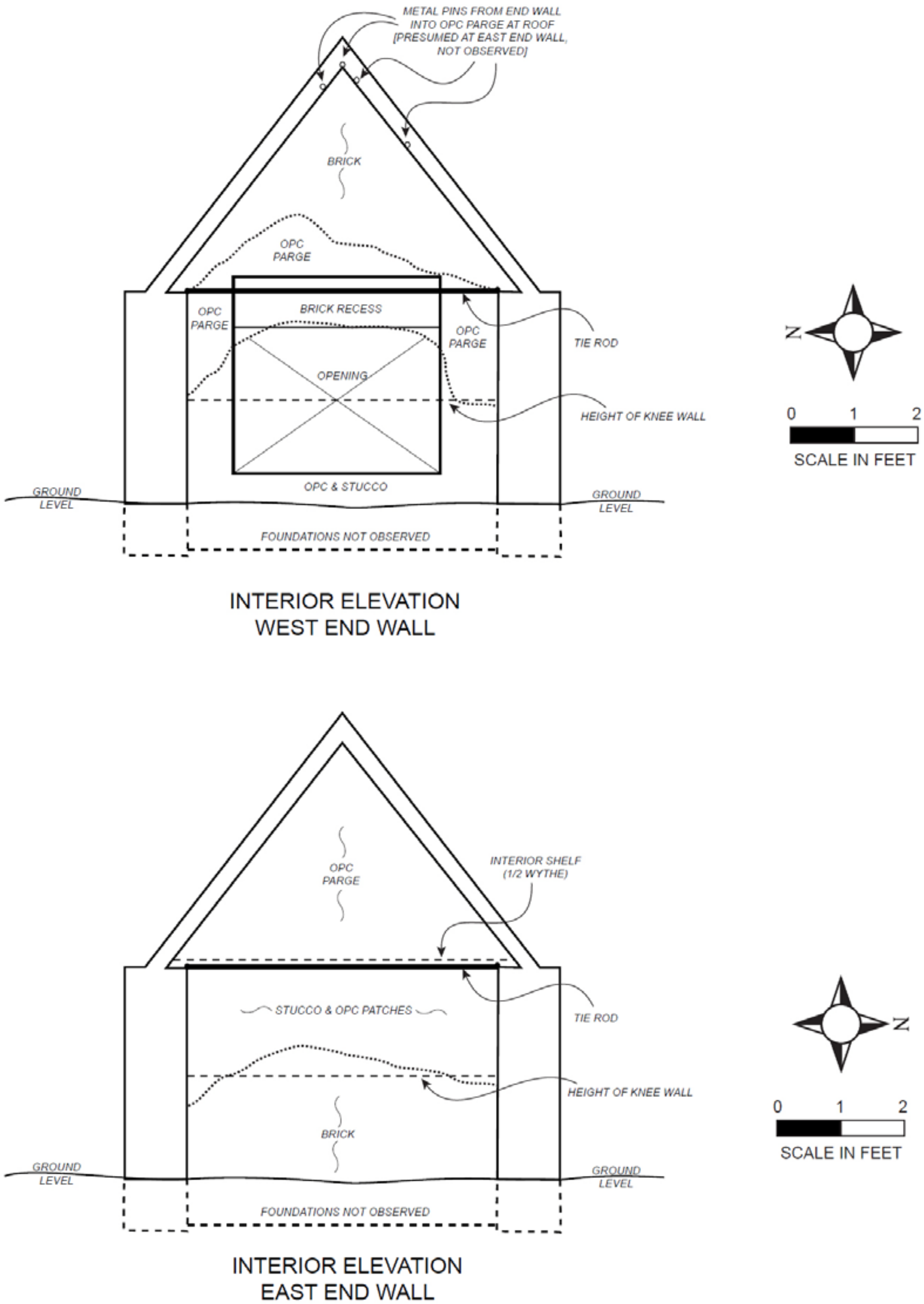


Figure 15. Vault 1 interior elevations. Upper drawing is the west end wall. Lower drawing is east end wall (drawings adapted from Towles 2014).

Figure 16. Structural analysis of Vault 1. Upper left photo shows how the cross tie rods have been anchored in excess Portland cement poured on the top of the side walls. Upper right photo shows chicken wire used to reinforce the slab roof. Middle left photo shows the large crack at the ridgeline. Middle right photo shows metal pins tying the end walls to the cement roof slab. Lower left shows water infiltration through roof cracks. Lower right photo shows the eastern knee wall and the use of OPC to repair cracks on the east wall (photos from Towles 2014).

the direction would have changed; perhaps the builders did not have enough long 1x8's to form out the entire roof. Metal pins tying the top of the end wall to the cement roof slab were observed near the ridge of the west end wall. Similar pins are assumed to exist at the east end wall but were not observed.

The cement slab is thinner at the ridge (as thin as ½-inch) than at the base of the roof (approximately 3-inches thick). This is possibly the result of using a relatively high-slump concrete (i.e., concrete with a high water content). This, in combination with the steep slope of the roof may have made it impossible to maintain a consistent roof thickness as the mix flowed down slope. Mixes with high amounts of concrete generally result in lower quality concrete.

The interior face of the west end wall (front wall with opening) transitions from the original stucco parge with some new ordinary Portland cement (OPC) patches at the bottom third of the wall, to a solid new OPC parge at the middle third, to exposed brick at the top third. The exterior face of the west/front wall has remnants of the original stucco at the bottom section of wall and at the lower portion of the top triangular section of wall. We know from the photograph from the first quarter of the twentieth century (Figure 5) that the upper portion of the top triangular section of this west end wall was reconstructed.

The interior face of the east end wall transitions from exposed brick at the bottom third, to the original stucco parge with OPC crack patches at the middle third, to a solid OPC parge at the top triangular portion of wall.

The exterior face of the east/rear wall has remnants of the original stucco throughout. As mentioned, a large marble plaque has been installed on the exterior of the east/rear end wall. The interior faces of both the north and south side walls have been fully parged with OPC. The exterior faces of the side walls have remnants of the original stucco, though it appears some bricks have been reset at the tops of these walls.

No excavation was made to determine the depth or composition of the foundation. No stones or slabs were observed at the base of walls, so we expect the brick walls were built directly on the soil at a very shallow depth below grade.

Condition Assessment

The primary concern with the structure is the roof and its connection to the side and end walls. While the roof does not show significant deflection overall, there is a large crack (up to 3/8-inch wide) that runs the length of the ridge line. There are also small hairline cracks that run from the ridge down to the tops of side walls. All of these cracks show water infiltration. A few remnants of the wood substructure remain, including nails connecting the beams and formwork planks to the slab itself. All observed metal nails and pins are corroded.

It is possible for gabled masonry roofs to be constructed such that the roof behaves similar to an arch – always in compression – and the outward thrust at the base of the triangular "arch" is resisted by the side walls. However, it does not appear that the Vault 1 roof was reconstructed in this manner. The sophistication of the construction indicates that the shallow OPC roof slab was likely originally supported by the wood substructure. With the decay of the wood substructure, the roof has shifted, as evidenced by the large ridgeline crack. This crack also creates a discontinuity indicating the roof is not fully in arch-like compression. The ridge peak has likely dropped somewhat, putting greater thrust on the side walls. We see evidence of outward deflection of these side walls in the OPC crack patches where the side walls tie into the end walls.

The roof in its current deformed condition is likely shedding loads in several different ways, as is expected for historic masonry. Given the loss of the ridge beam and the large discontinuity in the slab at the ridge crack, it is possible that the roof slab now partially spans in the long direction, from end wall to end wall. Structural analysis indicates that the slab does not have sufficient capacity to shed load in this manner alone. We do see that the chicken wire reinforcement is continuous across the ridge crack, and there is contact between some bricks at the ridge, so the roof slab may be exhibiting partial arch-like behavior as well. Since the roof and side walls are not significantly deflecting or cracking (other than at the roof ridge line), we conclude that the roof is in stable equilibrium under dead loads alone. However, should the roof see additional loads from wind or snow, it is quite possible that it will not be able to find new ways to shed this load and will collapse.

Beyond the capacity of the roof slab itself, its connections to the side and end walls are very important. A few steel pins connecting the roof slab to the gable end walls were observed. While they may exist, no steel pins tying the base of the roof to the tops of the side walls were observed. These connection conditions are another reason we believe the roof slab may be partially spanning in the long direction to the gable end walls.

The ¾-inch diameter steel ties that criss-cross the interior space to tie the tops of side walls together are mildly corroded. This corrosion has resulted in some negligible section loss. At first glance, it appears that the rods have necked at their ends due to "butterflying" out of the side walls. However, we believe it is more likely that these rods were shaped this way in order to more easily hook out the rod ends so they could be connected to the side walls. While the diameter of the rods themselves is more than sufficient for the task of tying the walls together, as mentioned above, it does not appear that the rods are connected directly to the side walls. It appears they are instead only set into the excess OPC that was poured on the interior shelf at the top of side wall. While this does provide some connection, OPC is not meant to perform as "structural glue." A more proper connection would be to the interior of the wall masonry or via a fish plate.

It does appear that the side walls did at some point begin deflecting outwardly due to thrust from the gabled roof as indicated by the OPC crack patches at the corner connections. The walls have not shifted significantly, and since we do not see new cracks in the patched joints (or in the adjacent bricks), it appears the movement has arrested. We expect that once the side walls first moved and the ridgeline dropped, the structure found a new equilibrium with new load paths, as described above, and the side walls did not see the same magnitude of load. The gable end walls are also in fair condition and do not exhibit significant deflection.

The foundation of the structure was observed to be level and in fair condition. No soil instability was observed.

Selected Preservation Option

While multiple levels of intervention were offered, Belvedere Property Management selected the least intrusive that focused on long-term monitoring combined with limited pointing of mortar on side walls. It was determined that roof rehabilitation would not be possible without complete reconstruction. Efforts to probe to verify conditions or install additional anchors, or local repairs such as replacement of cracked roof bricks, could destabilize the roof, resulting in collapse.

Since the current roof construction and materials are not original to the building, if the roof were to collapse (in the event of a hurricane, for example), it could be reconstructed with proper techniques and materials, and the reconstruction could be documented.

Mortar Analysis

Two samples were submitted for analysis, one from the south side within a deep joint that produced relatively soft, light gray mortar and another from the west end where a light gray stucco was obtained.

Petrographic Examination

The paste in both samples appears to consist of a major amount of hydraulic hydrated lime and residual glass silicate particles which are similar in appearance to residual hydraulic lime, possibly Roman cement. The paste color in both samples is light gray. Residual grains of Portland cement or natural cement were not detected. The hydrated lime appears to be a mixture of high-calcium and dolomitic types; it appears to be a hydraulic type. Evidence of slaked lime putty was found in both samples.

The paste in the mortar sample is soft, and is slightly harder in the stucco sample. The paste in both samples is carbonated, with a light gray color. The paste-aggregate bond and the mortar firmness appear moderate in both samples. The degree of hydration is advanced. A few pockets of dispersed hydrated lime are present. Lumps of slaked lime were detected in both. Secondary calcium carbonate is present. Brick fragments are not present on the mortar sample. Some wood fragments are present within the stucco sample.

The aggregate in both samples is a natural sand with a 2.0 mm maximum grain size and a modal (most frequently occurring) grain size of approximately 0.28 mm. The particle grading appears slightly finer than the natural sand grading specified in ASTM C144 (aggregate for masonry mortar).

The sand consists of limestone, quartz, and orthoclase feldspar. The aggregate is in a physically and chemically stable condition. The sand content appears low in both samples.

In both samples, the mortar is not air-entrained, and has a normal entrapped air content of approximately 3.0-to-5.0%. The majority of air voids are irregular in shape, and appear entrapped.

Chemical Analysis

The binder in the mortar appears to consist of dolomitic hydrated lime, which is likely hydraulic. The paste in both samples is carbonated. Brucite (magnesium hydroxide) was detected at a low to moderate amount in both samples, indicating the hydrated lime is an impure, dolomitic type. The binder in both samples appears to be a mixture of hydrated lime and silicate. The hydrated lime in both samples was estimated to contain 30.0% soluble SiO_2; 40% calcium oxide (CaO); and 10% magnesium oxide (MgO), which is equal to 14.5% brucite ($Mg(OH)_2$). The hydrated lime was calculated based on the amount of SiO_2 and brucite. Brucite content was quantified using Differential Scanning Calorimetry (DSC) – Thermal Analysis.

Limestone was detected in both samples and the aggregate contents were calculated by difference: 100.0% minus the sum of: free water plus hydrated water and hydrated lime. The densities (loose volume basis) of the mortar ingredients were assumed to be those listed in ASTM C270. Eighty lbs. of dry sand was assumed to be equal to one cubic foot of damp loose sand.

Table 4.
Mortar and Stucco Composition

	Mortar	Stucco
Constituent		
silica (soluble SiO_2)	5.37	6.31
calcium oxide (CaO)	25.32	24.44
magnesium oxide (MgO)	3.58	4.21
brucite ($Mg(OH)_2$)	2.58	3.03
insoluble residue	62.11	50.34
Loss on Ignition (% by mass)		
at 0-110° C - free water	0.06	0.09
at 110-550° C - hydrate water	2.76	3.71
at 550-950° C - CO_2	11.31	12.11
Calculated Constituents (% by mass)		
hydrated hydraulic lime	17.9	21.03
fine aggregates (sand)	79.28	75.17

However, hydraulic lime putty is estimated at 100 lbs./ft.^{3} instead of 80 lbs./ft.^{3}, consisting of 50% free water and 50% hydrated lime (calcium hydroxide), and the hydrated lime was assumed to have a bulk density (loose) of 50.0 lbs./ft.^{3}, instead of 40.0 lbs./ft.^{3} as specified in ASTM C270.

The hydrated lime in both of these samples appears similar to a Roman cement, which is a mixture of hydraulic, slaked free lime (CaO), and volcanic ash, or a calcined clay with hydraulic lime.

The volumetric proportion of the mortar sample (determined according to ASTM C270) is 1 part hydrated hydraulic lime to 2.77 parts natural sand. The proportion of the stucco is 1 part of hydrated hydraulic lime to 2.23 parts natural sand.

Based on the chemical analysis results, the mortar and stucco samples do not conform to any proportion type specified in ASTM C270. They both appear to be hydrated lime with fine sand. The binder appears similar to Roman Cement, a mixture of hydraulic hydrated lime and volcanic ash, or hydraulic hydrated lime with calcined clay.

In the mortar sample, the bulk volume of sand is 2.77 times the volume of the hydrated lime, which conform to ASTM C270 for sand content. In the stucco sample, the bulk volume of sand is slightly low, at 2.23 times the volume of the hydrated lime, which nearly conforms to ASTM C270 for sand content.

Field Procedures

Upon opening the west entrance, a large mass of collapsed wood was the first observation. This debris, consisting of 2x4s, 1xs, and 2x6s, was removed from vault by section. These sections were defined by the three knee walls that created four sections, identified from west to east as A, B, C, and D. This wood was discarded without additional analysis since it is thought to represent the most recent roof repair effort. This recent debris in all four sections was identified as Level 1. This level was about 0.2 foot in depth (not counting the wood debris that were leaning against walls or otherwise above the ground surface).

Figure 17. Vault 1 opened, exposing Level 1 debris. Upper photo shows the vault opened and view at the entrance. Middle photo shows the debris looking east. Lower photo shows the wood debris removed from Level 1.

Figure 18. Composite view of the interior floor of Vault 1 showing the three knee walls and four excavation sections. West is at the top of the photo.

Level 2 was found to be a mixed zone incorporating brick and mortar rubble with minor amounts of a brown humic soil from the most recent roof collapse. Its presence indicates that the twentieth century repair effort did not seek to remove much the collapse – the repair effort was conducted with the debris left intact. The depth of Level 2 was 0.2 foot.

The final level (Level 3) consisted of dark brown sandy soil. Comingled were fragments of coffin wood, bone, brick fragments, and mortar. This level was 0.3 foot in depth.

At the base of the tomb is a poorly laid brick floor. There may have been little reason to carefully lay a floor that would never be seen. In a similar fashion the outer brickwork itself is poorly laid, probably because stucco was intended to cover the brick and create a entirely different appearance.

The knee walls were constructed on top of this floor (stucco is visible between the knee walls and the outer vault walls) and abutted the north and south walls. The distance between the knee walls was not uniform, varying from 1 foot up to 1.75 feet. The reason for the variation is unknown, but we assume that it was of little or no consequence. The function we believe was to keep the caskets off the ground and these knee walls occurred in all four vaults. In Vault 1 these walls were between 20-inches and 21-inches off the floor.

We discovered mortar lumps at the four corners of Section A, along the north and south walls of Section B and adjacent to the knee walls to the east and west, along the eastern knee wall in Section C, and along the north and south walls of Section D. These large lumps were an old lime-based mortar, probably original to the construction of the tomb. The function of these lumps, however, is not known.

As explained previously, all of Level 3 (excepting large brick and wood fragments) was screened through ⅛-inch mesh. We found that the rubble to soil ratio (by volume) was 12:1. Most of the “soil,” in each level, consisted of mortar fragments.

The very high incidence of rubble is thought to be the result of at least two separate repair efforts. In addition to the most recent – when little of the rubble was removed – there was a much earlier effort that involved removing as much of the coffin wood and all of the readily identifiable human bones to the eastern edge of the vault (i.e., Section D). While human bone was found elsewhere, they were only small fragments that could be easily overlooked in the soil.

Moreover, as will be discussed in our analysis of the human remains, we found significant portions of two additional individuals that originated in Vault 3, but which were moved into Vault 1 and comingled with the one occupant of Vault 1. We presume this move was necessitated by repairs to Vault 3 that took place sometime in the late nineteenth or very early twentieth century, perhaps even at the same time the initial work was being performed on Vault 1. For whatever reason the individuals from Vault 3 were never returned – likely because the laborers simply didn’t know who belonged where after the work was completed.

Table 5.
Artifacts Recovered from Vault 1

	Section A	Section B	Section C	Section D	Total
Nail fragments	9	110	16		135
Nails, Hand Wrought, 1½"	1				1
Nails, Hand Wrought, 2½"		4			4
Ferrous tacks, 5/16"	7			3	10
Ferrous tackes, 9/16"	20	10			30
Ferrous tacks, 10/16"	2	2			4
Flat iron, lug fragments	40	9			49
Large Handles		3		7	10
Small Handles		1		1	2
Brass tacks, medium, .39-.42" (3/8 - 7/16")	4	34	18	1104	1160
Brass tacks, small, .32" (5/16")		7		25	32
Green glass frag	2	1			3
Mortar frag with coffin wood impression				1	1
Prehistoric					
Cape Fear Fabric Impressed	1		1		2
Wilmington Fabric Impressed			2		2
Oak Island Simple Stamped	1				1
Oak Island Fabric Impressed			1		1

Artifacts

The artifacts recovered from the interior of Vault 1 are itemized in Table 5. All artifacts are being reinterred with the human remains.

Prehistoric Specimens

Of some surprise was the recovery of six Woodland Period Native American pottery sherds. These include two Cape Fear Fabric Impressed, two Wilmington Fabric Impressed, one Oak Island Simple Stamped, and one Oak Island Fabric Impressed. These span the Middle and Late Woodland periods, about 300 B.C. through perhaps A.D. 1600 (Eastman 1991, Ward and Davis 1999).

These remains may have been collected with shell from a prehistoric midden to be burned for lime or may have been encountered during the excavation for the vault. How these few remains became incorporated in the vault is more difficult to understand.

Non-Burial Historic Remains

Like the accidental occurrence of six prehistoric sherds, the excavation also produced three fragments of green glass. These are small, but the color and thickness is suggestive of a pharmaceutical bottle.

Burial Artifacts

There were 1,440 specimens, not including wood fragments, associated with the one burial from Vault 1 and the remains added

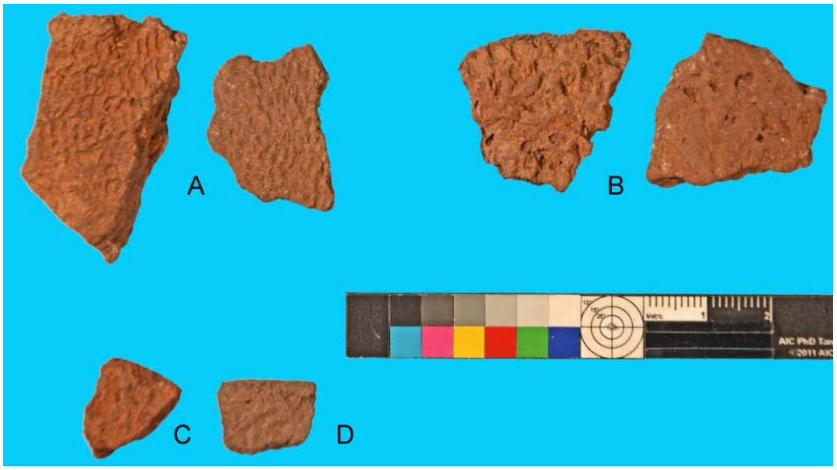


Figure 19. Prehistoric pottery recovered from Vault 1. A, Cape Fear Fabric Impressed; B, Wilmington Fabric Impressed; C, Oak Island Fabric Impressed; D, Oak Island Simple Stamped.

from Vault 3.

These included 135 nail fragments too corroded and fragmentary to further identify. While there may be a few from more recent repairs, we expect that most of these represent nails used in the manufacture of the coffins.

Two of the nails were readily identified as hand wrought. One was 1½-inches (4d) in length and the other was 2½-inches (8d) in length. These represent a size range that we have observed in the past in association with coffins.

There were 44 ferrous tacks ranging in size from 5/16-inch to 10/16-inch, with the most common being 9/16-inch.

Tacks, being a very humble artifact, are rarely given much discussion by archaeologists. Even Noël Hume deals with furniture tacks in one sentence: “small tacks were used around the skirts of seventeenth-century chair seats and it is impossible to distinguish these and the common upholstery tacks of the eighteenth century” (Noël Hume 1978:227).

A few researchers are not so cavalier in their dismissal. Jobe, for example, notes that “the differences between eighteenth-century examples and their modern counterparts are quite marked” (Jobe 1987:72). Prior to about 1790, tacks were made of hand forged shanks with hammered heads – similar to nails. Cut shanks were introduced in the 1780s, although the heads continued to be hammered by hand. It wasn’t until the nineteenth century that machine-stamped heads replaced hammered ones (see also Anonymous 1881).

Tacks have generally been measured overall, including the head, with the measurements in 1/16-inch increments (thus a tack ½-inch in length would be described as measuring 8/16-inch). They were sometimes also referred to by an ounce designation. This, however, referred to the thickness of the leather the tack was able to clinch. Thus, a 9/16” tack might also be described as an 8 ounce tack.

Their value to us is that they demonstrate that coffins found in the vault had fabric linings,

Figure 20. Hand wrought nails from Vault 1.

even though no fabric was recovered. Elsewhere Noël Hume does mention this practice briefly (Noël Hume 1969:158).

Also recovered from Vault 1 were 1,192 brass dome-headed tacks. These historically were measured from under the domed head to the point. They would often be identified by both the diameter of the head, as well as the shank length. We grouped these tacks into two categories. There were only a few with a small head diameter (5/16-inch). Most were placed in a medium size range that varied from about ⅜-inch to 7/16-inch in diameter.

Figure 21. Ferrous tacks from Vault 1.

Similar tacks are briefly mentioned by Stone (1974), where head diameters vary from 9 to 12 mm (⅜ to ½ inch).

Noël Hume is more impressed by these artifacts, describing in more detail their use as decorative items. He notes that, "many coffins did not aspire to plates but had the occupant's initials and date of death spelled out in brass furniture tacks on the lid, while their edges and sides were sometimes decorated in floral or geometric tacked designs" (Noël Hume 1969:158). A brief review of one source (Cox 1998) found that while both ornate use of brass tacks (observed in Figure 6.4) and initials and date (observed in Figure 12.3) occur, far more common was the linear arrangement of tacks (seen in Figures 1.6, 6.2, 6.7, 6.8a, 6.9, 6.10, and 7.3).

The examples of tacks on wood fragments from Vault 1 revealed only linear arrangements, with the tacks averaging about ¾-inch apart. The smaller tacks seem to have been used as accents and were placed abutting one another.

Also recovered were 10 large coffin handles and two smaller coffin handles.

Readers should remember that Vault 1 included three individuals: two adults and one infant, with one adult and the infant having been moved into Vault 1 from Vault 3. Therefore, it is important to understand that these handles represent three coffins.

If we assume that all of the handles were collected and that all have survived, then it becomes difficult to ascribe handles to coffins known to be present. Given the condition of the recovered specimens, it seems reasonable that we have some loss, either during movement from one location to another or through deterioration within the vaults.

We believe that the large handles were used on the two adult coffins, likely three per side, so that two handles have been lost. The infant coffin almost certainly used the small handles, likely with two per side, so that two of these have also been lost over the years.

The small and large handles have slightly different profiles, with the large handles measuring 4¾-inches in length and having a more bulbous and slightly curved bail handle. In contrast, the smaller handles measured only 4¼-inches across and were both straight and relatively thin. In both cases, however, they were attached to thin metal lugs with a stamped design. These have almost completely corroded away, with only a few small fragments being recovered.

Figure 22. Examples of brass tacks on coffin wood from Vault 1. Upper two photos show arrangement and spacing of tacks. The lower photo shows tacks on two faces of a coffin shoulder.

Figure 23. Combination of small and larger tacks.

Twenty-five wood fragments were identified as coffin remains because of their shape and/or the presence of brass tacks. Five of these wood fragments were randomly selected for examination of wood and all were identified as pine (*Pinus* sp.). These fragments were consistently just under an inch in thickness.

The fragments at Orton provide numerous examples of hexagonal shapes (see, for example, Figure 22). Nine fragments were found exhibiting 10 angled joints. Since each coffin top would have six such angles, for a total of 18, the remains identifiable in Vault 1 represent about half of what originally existed. At Orton the angle of the head joint ranged from 118° (2) to 120° (2). The angle of the shoulder joint ranged from 156° (2) to 160° (1), and the angle of the foot joint ranged from 109° (2) to 112° (1). Thus, it appears that the Orton coffins were all very similar in design and layout.

Fabrics

While no textiles were recovered, we did find one metal fragment that had a textile weave impressed in the corroded metal. It likely represents interior coffin lining since any exterior fabric covering would have been preserved by the abundance of brass tacks. It is also possible that the fabric is that of the shroud.

While the impression provides few clues concerning the original material or its color, it reveals a thread count of about 250 threads per

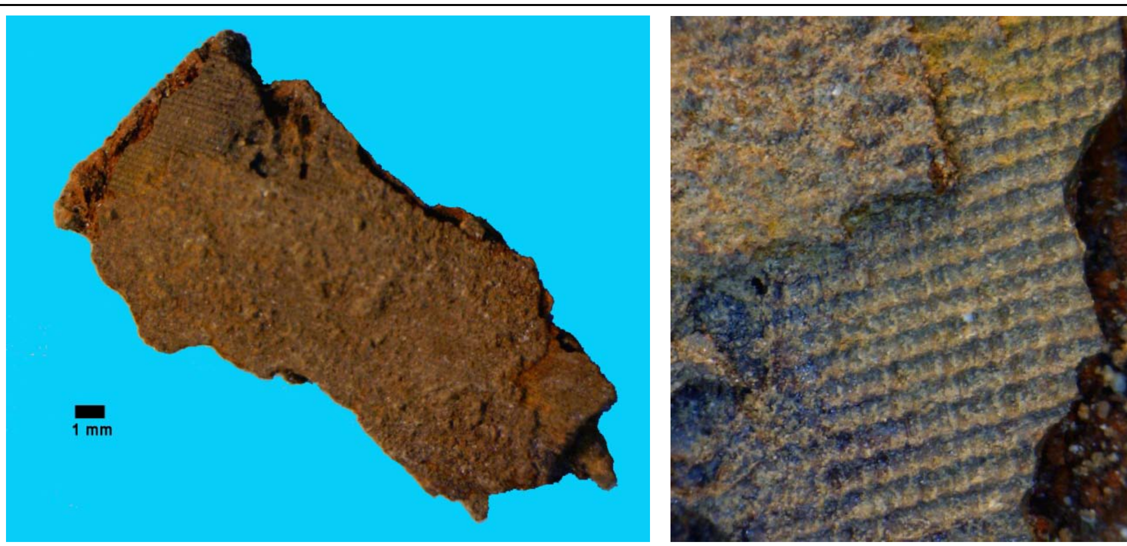


Figure 24. Fabric impression from Vault 1. On the left is the metal fragment with the impression in the upper left corner (20x). On the right is a close-up of this fabric impression (70x).

inch. This is consistent with finely woven broadcloth or linen.

Plume notes that by the nineteenth century the interior of English coffins were sealed with pitch, then sawdust, bran, cotton waste, or similar material was used as padding. Over this calico was laid and tacked down (Plume 1902:21). Later alternatives included flannelette and swansdown (Hasluck 1913:52).

This calico was the unprinted, gray cloth common in England from about 1700 on. It was a plain-woven textile made from unbleached, and often not fully processed, cotton.

Table 6.
Radiocarbon Date of Coffin in Vault 1 (Beta-369542)

Conventional radiocarbon age:	140±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1670 to 1780 and Cal AD 1800 to 1890 and Cal AD 1900 to 1950 and Cal AD 1950 to post 1950
1 sigma calibrated results: 68% probability	Cal AD 1680 to 1700 and Cal AD 1720 to 1760 and Cal AD 1770 to 1780 and Cal. AD 1800 to 1820 and Cal AD 1830 to 1880 and Cal AD 1920 to 1940 and Cal AD Post 1950

Radiocarbon Dating

Since the vault included no name plates and there is no accurate family tradition regarding who was buried in the tomb, there was no means to determine when the vault was constructed or used. In an effort to resolve that issue a fragment of the wood coffin (identified as such by the attached brass tacks) was submitted for AMS (accelerator mass spectrometry) dating using standard practices by Beta Analytic Radiocarbon Dating Laboratory (Beta-369542).

Multiple calibration ranges were reported, reflecting "wiggles" in the calibration data in the time range of the Conventional Radiocarbon Age. These wiggles create gaps in the calendar time scale corresponding to the section of the calibration curve which go outside of the precision limitations on the BP date.

Both the one and two sigma calibrated results are shown in Table 6. In some cases it is possible to exclude some of the ranges based on other lines of evidence.

We believe it is reasonable to exclude dates prior to the establishment of Orton (ca. 1727-1730) and to exclude those dates after the sale of Orton out of the Moore family (1778). Using the one sigma ranges, this still leaves the coffin wood perhaps dating from AD 1720 to 1760 or AD 1770 to 1780. These dates span the entire period of Roger Moore's ownership, as well as the period during which William Moore's son Roger controlled the property.

Table 7.
Radiocarbon Date of Burial A in Vault 1 (Beta-372900)

Conventional radiocarbon age:	80±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1685 to 1730 and Cal AD 1810 to 1925 and Cal Post AD 1950
1 sigma calibrated results: (68% probability)	Cal AD 1695 to 1725 and Cal AD 1815 to 1835 and Cal AD 1880 to 1915 and Cal Post AD1950

In an effort to refine the date, we decided to submit a small rib fragment for AMS dating of bone collagen (Beta-372900). The results of this effort are shown in Table 7.

These dates provide refinement, but they suggest a burial date either very early in the Moore tenure (prior to 1730) or a burial date after

Figure 25. Handles and lugs. The upper photo shows the small and large handles. The lower photo shows fragments of the stamped metal lugs associated with the handles.

the Moores lost control of the plantation (after 1830, although perhaps as early as 1815).

Absent good genealogical data, the precision of radiocarbon dating is simply not sufficient to allow a tighter time frame for the use of the vault.

Skeletal Remains

The skeletal materials in Vault 1 were intermingled and scattered in the eastern, or rear, section of the vault. All remains were in poor condition, fragmented, fragile, and worn. These conditions were undoubtedly caused by the intrusion of water during rains, as well as tidal surge from hurricane activity. Due to cracks and holes in the vault itself there was also considerable animal intrusion over the years; during disinterment three large black snakes were found living in the space.

Identifiable skeletal material was separated and sorted according to size and robusticity. After the sorting, it was determined that there were the remains of three individuals in the vault; only individual A is believed to have been originally interred in this vault. Individuals B and Z were originally interred in Vault 3, but at some point moved to the rear section of Vault 1, probably as a result of the opening and repair work conducted at Vault 3. The remains originally from Vault 3 will be discussed in that section.

Individual A

Fifty bone fragments were identified as Individual A, an adult female. The bone was in poor, fragmented, gnawed, and eroded condition.

All post-cranial epiphyses had complete union, indicating an age of over 30 years (Buikstra and Ubelaker 1994:43). All ectocranial sutures were open, indicating an age of 22 to 45 years (Buikstra and Ubelaker 1994:38). The auricular surface is a phase 7, with a lipped, irregular surface and margins, dense bone with patches of porosity, indicating an age of 50 to 59 years (Buikstra and Ubelaker 1994:25). All permanent teeth had erupted and were fully formed, indicating an age of over 30 years (Hillson 1996:145). Given these markers, this individual appears to have been between 35 and 59 years of age at death.

While 32 permanent teeth had erupted and formed fully antemortem, as shown by the intact bone, 11 teeth were missing postmortem. Only one caries was noted, in the center occlusal area of 31 M2, the mandibular right 2nd molar. There was moderate to significant wear on the occlusal surface of all teeth, with lines of dentin exposed on the incisors, signifying the effects of biting and chewing. Only small amounts of calculus, or tartar, were seen on the teeth. The teeth were well formed and straight, excepting tooth 26 I2, the mandibular 2nd incisor, which was located slightly to the interior of mouth. Overall, the teeth were in very good condition for an adult of the late eighteenth century.

The innominate, or pelvis, indicates that this individual was female. Overall, the flared ilium, round pelvic inlet, wide sciatic notch, elevated sacral articulation and wide preauricular surface are all morphological indicators of a female (Buikstra & Ubelaker 1994: 18).

The skull is small and gracile, with sharp orbital borders, small supraorbital ridges, rounded profile, faint temporal muscle lines, rounded occipital profile, and no nuchal crest; the chin is slightly pointed. These morphological characteristics indicate that this individual was female (Bass 1995: 86)

Determination of ethnicity is based on the measurements and morphology of the facial portion of the skull. Because all of the facial bones are missing postmortem, determination could not be made; however, given that all other individuals in the cemetery were of Caucasian, or European, descent, it is likely that she was as well.

The left femur is 2mm shorter than the right femur, the left tibia is 6mm shorter than the right, and the combined femur-tibia length is 10mm shorter than the right, creating an overall height difference of more than 1-inch. The distal

Figure 26. Vault 1, Individual A, cranium and mandible. Upper left is a lateral (right) view of the cranium. Upper right is a superior view of the cranium. Lower left is an inferior view of the maxilla. Lower right is a superior view of the mandible.

Figure 27. Vault 1, Individual A, right ilium, interior view.

Figure 28. Vault 1, Individual A, lower back. Upper left photo is a posterior view of the sacrum. Blue fabric is used to illustrate the absence of bone formation caused by spina bifida occulta. Upper right photo shows a superior view of the 8th thoracic vertebra. Note osteophytic growth and laminal spurs. Lower photo is an inferior view of the 4th lumbar vertebra showing a Schorl's node.

ends of both femurs show moderate lipping and modeling above the patellar surface; anterior portions of the both tibial condyles are also lipped; the right fibula has lipping and osteophytic build up on the posterior portion of the styloid process; the left fibula has minor lipping on the posterior portion of the styloid process, but no osteophytes. These differences and modifications seem to indicate the individual favored her right leg. The lengths of the long bones indicate a maximum stature of 5'1" to 5'5" (Bass 1995: 29).

The sacrum is crumbled and fragmented, but it can be seen that the dorsal wall of two segments was not completely formed. The dorsal wall should be complete by the age of 12 to 15 years (Baker et.al. 2005: 159). The condition in which it never develops is called spina bifida occulta (SBO), a mild form of spina bifida, and occurs in 10-20% of the modern population. In this condition, the deformity of the spinal bone is covered by fatty tissue and skin, and can only be diagnosed by spinal x-ray or magnetic resonance imaging (MRI) (Judd 2013: 537).

Spina bifida was first described in medical literature in 1882 by Recklinhausen (Aufderheide & Rodriguez-Martin 1998: 61). While this condition is asymptomatic in many cases, there may be neurological problems associated with SBO, including back or leg pain or weakness, or back or leg deformity. Eighty percent of people with SBO have changes to the skin above the deformed area, for example: a hairy patch, a fatty lump, a large red birth mark, a hypopigmented spot, or a deep dimple. None of these are health hazards, but simply indicative of the underlying defect (Spina Bifida Occulta Health Info Sheet, Spina Bifida Association, http://www.spinabifidaassociation.org).

Individual A had a moderate to severe case of spina bifida occulta.

No cervical vertebrae were recovered. All thoracic and lumbar vertebrae had moderate lipping and osteophytes on inferior and superior bodies. This is evidence of moderate osteophytosis, or the degeneration of intervertebral disks, a symptom of osteoarthritis. As the intervertebral disks degenerate, the vertebral bone on either side begin touching; as a reaction to the bone contact, the body creates a protective barrier of bone, or osteophytes on the inferior and superior aspects of the vertebrae . As the condition continues, the osteophytes can develop from spurs to lipping (Steele & Bramblett 1988: 136). The porosity and pitting of the vertebral bodies is also seen as a result of osteoarthritis (Aufderheide & Rodriguez-Martin 1998: 97).

Thoracic vertebrae 2 through 12 also had moderate laminal spurs, or spiked bone growth, along the superior border of the neural arch. This is known as spinal stenosis or the narrowing of the spinal canel, is most often located in thoracic vertebrae, and is associated with increasing age (Mann & Hunt 1990: 87). In this case, the spurs have narrowed the openings in the spine that allow the passage of nerves from the spinal cord to other parts of the body; this condition can cause weakness and pain in the back and the legs, especially when standing or walking (Sutton 2004: 359).

A Schmorl's node was located on the inferior surface of fourth lumbar vertebra, and is evidence of a herniated disk. This is common in individuals over the age of 45 (Aufderheide & Rodriguez-Martin 1998: 97). As the disk herniated, it actually protruded into the vertebral surface, causing a bone defect of 7.0mm x 4.0mm, and 3.0mm in depth. While herniation is common in elderly, as the result of degenerative disk disease, it is also common in even mild cases of spina bifida (Mann & Hunt 1990: 95). It may cause pain or tingling in the back or legs.

The bone provided for DNA analysis showed a maternal relationship with the Individuals A, X, Y1 and Z1 of Vault 2, and is likely their mother. She also shared a maternal relationship with Individual A in Vault 4 and may have been that individual's sister. DNA also noted that this individual was of European descent (Fratpietro 2014a, 2014b).

In summary, this individual was an adult female of European descent, between the 45-60 years old at death. Her maximum height would have been between 5’1” and 5’5”, and her teeth were in very good condition. This individual probably suffered back pain or weakness due to osteoarthritis in the spine. The mild Spina Bifida Occulta does not appear to have altered her spinal shape or posture, although she appears to have favored her right leg, thus walking with a small limp, since childhood.

Vault 2

Vault 2 is situated in the northeast corner of the cemetery, immediately east of Vault 1. It is similar to Vault 3, both consisting of a barrel arch tomb. When encountered it exhibited extensive deterioration of the arched roof and numerous repair episodes using a hard ordinary Portland cement (OPC). The tomb required total repointing. The tomb is unmarked and family legend provided no information on who might be buried in the vault.

Our study revealed that the tomb included an adolescent male and six infants.

There is no institutional history associated with the vault. It is glimpsed in the lower left of Figure 6, likely from the 1950s. At that time the vault appeared in better condition than we found it 60 years later; thus, it seems that many of the problems occurred in the latter half of the twentieth century and repair efforts used inappropriate materials and techniques. As a result, in some areas it become difficult to know how the vault was originally constructed.

Figure 29. Vault 2. Upper photo shows the vault after pointing looking northwest. Lower photo shows the vault looking east toward the rice fields.

Construction Details

Vault 2 consists of unreinforced brick masonry side and end walls and a barrel vaulted roof of brick masonry. The overall exterior plan dimensions are 5-feet 1-inch wide by 9-feet 4-inches long with side wall heights of 2-feet 5-inches and a interior height from floor to centerline of the barrel vault of 4-feet 8-inches. Brick sizes vary and some obviously modern bricks are incorporated into the barrel vault repairs. What appear to be historic bricks average approximately 4-inches wide by 9-inches long by

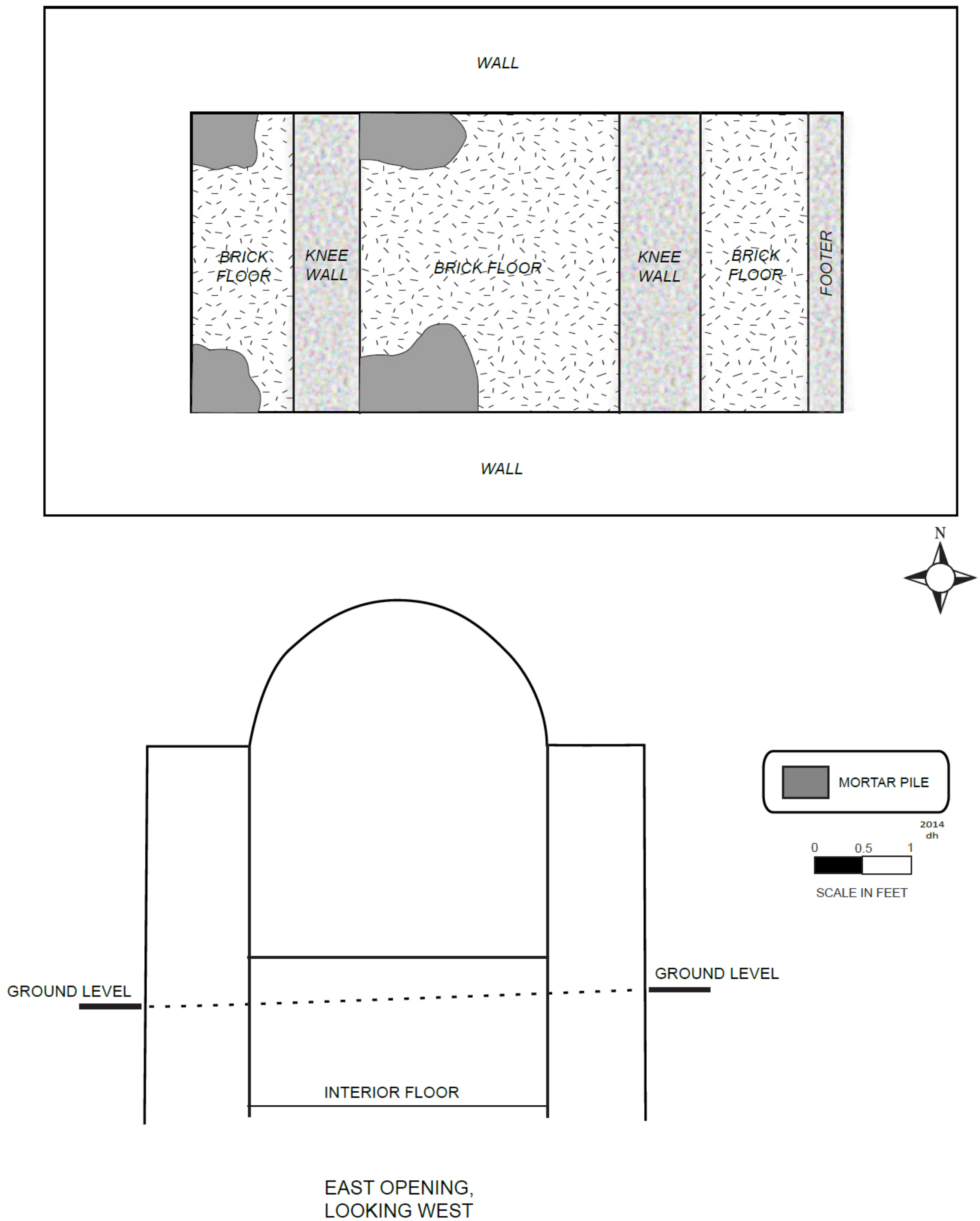


Figure 30. Vault 2 plans. Upper drawing is the floor plan. Lower drawing is the east end wall.

Figure 31. Vault 2 upon opening. Upper photo shows the removed eastern wall and vault interior. Lower photo shows brick and mortar rubble mixed with wood and skeletal remains.

3-inches tall.

The long north and south side walls are three brick wythes thick (about 12-inches) at their thickest points. Both walls also have two half-wythe recesses. The west wall is about 17-inches thick (4 wythes), while the east wall is 3 wythes thick (although the measurement is close to 15-inches, indicating abundant use of mortar). Interior dimensions are 6-feet 7-inches in length by 3-feet in width. The floor is brick masonry and there are two 8¾ to 9¾-inch knee walls running north-south that divide the interior into three spaces ranging from 11½-inches at the west end, 2-feet 8-inches in the middle, and 1-foot at the east end.

While no mortar analysis was conducted for Vault 2, where original, soft mortar was encountered, it was visually identical to that reported for Vault 1. Original mortar was not, however, common as the vault had been subjected to at least three repair episodes, including extensive repair of the barrel roof vault. Two different types of replacement bricks were present. It appears that the western third of this roof collapsed, resulting in extensive repairs. Today the roof has a "sway-back" appearance because the original vault lines were not maintained.

Field Procedures

Upon opening the east entrance, we observed a floor consisting of brick and mortar rubble, a few fragments of recognizable wood, and occasional bone fragments. There was no indication of the knee walls since the fill covered them entirely.

The debris were removed from the vault by section. These sections were defined by the two knee walls that created three sections, identified from east to west as A, B, and C. We found the soil to be homogenous, with no distinct levels or zones. Consequently, the 0.7 foot of soil was removed as one level. This level consisted of dark brown sandy or gritty soil. All fill was screened through ⅛-inch mesh. We found that the rubble to

Figure 32. Excavation of Vault 2. The upper photo shows the soil and mortar matrix in which remains were recovered. The lower photo shows excavations in progress.

soil ratio (by volume) was 6:1. If the abundant brick fragments were included with the mortar, the ratio would be closer to 9:1 by volume. Thus, while there was organic soil that we presume was formed from decomposition and perhaps minor storm flooding, most of the fill consisted of mortar debris, from either the original construction or the various repair episodes.

In contrast to Vault 1, the floor in Vault 2 was relatively well laid and clearly more effort went into the construction of this floor than did the floor at Vault 1. Otherwise, the outer brickwork of the vault is poorly laid, probably because stucco was intended to cover the brick and create an entirely different appearance.

The knee walls were constructed on top of this floor and abutted the north and south walls. As with Vault 1, the distance between the walls is not uniform. In addition, the heights of these walls varied by about an inch, suggesting little care in their execution. As elsewhere, we believe the function was to prevent coffins from sitting on the vault floor.

Also similar to Vault 1, we discovered lumps of pure lime mortar in four locations: at the northwest and southwest corners of the vault, and at the northeast and southeast corners of the western-most knee wall. While they appear to be original to the construction of the vault, their function is uncertain. One possible explanation is that they were added to help retain infant coffins that might otherwise have been unstable.

We were able to distinguish two distinctly different woods. Some fragments were similar to plaster lathe and were apparently installed north-south, with supports running east-west. These, we believe, served as supports for the construction of the roof vault. Supporting this is the abundant mortar we recovered with lathe-like wood impressions. This wood was discarded without additional analysis. Other remains were all collected for analysis and reburial.

As will be discussed in our analysis of the


Figure 33. Vault 2 after excavation showing Section C (at rear) and Section B, separated by a knee wall.

human remains, we found one adolescent male and six infants. Remains were not well articulated in the vault. For example, in the southwest corner of the vault we found brick overlying adolescent skeletal elements that were overlying remains of an infant. This may be the result of movement to allow repairs, although it seems more like displacement resulting from low velocity flooding.

Artifacts

The artifacts recovered from the interior of Vault 2 are itemized in Table 6. All artifacts except the four modern items are being reinterred with the human remains.

Modern Specimens

Just as Vault 1 produced a few prehistoric sherds, Vault 2 produced a few modern artifacts that we presume were deposited during the various repairs. Recovered was a suspender button, and three pointed screw fragments.

The suspender button (South's Type 32) could be found on work pants, such as jeans, prior to 1937 and is still found on bib overalls. This item likely dates to the first half of the twentieth century.

The "modern" gimlet point screw was developed during the first third of the nineteenth century (White 2005) so these may be associated with one or more of the coffins. However, given that only three were identified, we have elected to identify them as modern intrusions.

Burial Artifacts

There were 741 specimens, not including wood fragments or animal bones, associated with the six infants and one adolescent burial from Vault 2.

These included 208 nail fragments too corroded and fragmentary to further identify. We anticipate that virtually all of these represent nails

Figure 34. Lathe-like impressions in lime mortar.

Table 8.
Artifacts Recovered from Vault 2

	Section A	Section B	Section C	Total
Nail fragments	75	89	44	208
Nails, Hand Wrought, 2½"	5	4	3	12
Nails, Hand Wrought, 3"			1	1
Brass fragment	1			1
Ferrous tacks, 8/16", flat head	11			11
Flat iron, handle fragments	7	1	10	18
Handles	1	10	3	14
Brass tacks, large, .48-.53" (8/16")	39	29	123	191
Brass tacks, medium, .39-.42" (3/8 - 7/16")	58	18	55	131
Brass tacks, small, .32" (5/16")	68		33	101
Tacks in wood fragments		51		51
Brass straight pins		2		2
Animal bones	27	42	223	292

used in the manufacture of the coffins.

Thirteen of the nails were readily identified as hand wrought. Twelve were 2½-inches (8d) in length and the other was 3-inches (10d) in length. These tend to be slightly larger than those found associated with similar coffins in the past. It is possible that some, or all, represent nails used in making the frame to support the construction of the brick arch, leaving the fragments representing those used in the coffins.

There were 11 ferrous tacks, all measuring 8/16-inch, within the range observed from Vault 1.

Tacks, being a very humble artifact, are rarely given much discussion by archaeologists. Even Noël Hume deals with furniture tacks in one sentence: "small tacks were used around the skirts of seventeenth-century chair seats and it is impossible to distinguish these and the common upholstery tacks of the eighteenth century" (Noël Hume 1978:227).

A few researchers are not so cavalier in their dismissal. Jobe, for example, notes that "the differences between eighteenth- century examples and their modern counterparts are quite marked" (Jobe 1987:72). Prior to about 1790, tacks were made of hand forged shanks with hammered heads – similar to nails. Cut shanks were introduced in the 1780s, although the heads continued to be hammered by hand. It wasn't until the nineteenth century that machine-stamped heads replaced hammered ones (see also Anonymous 1881).

Tacks have generally been measured overall, with the head included, with the measurements in 1/16-inch increments (thus a tack ½-inch in length would be described as measuring 8/16-inch). They were sometimes also referred to by an ounce designation. This,


Figure 35. Nails from Vault 2.

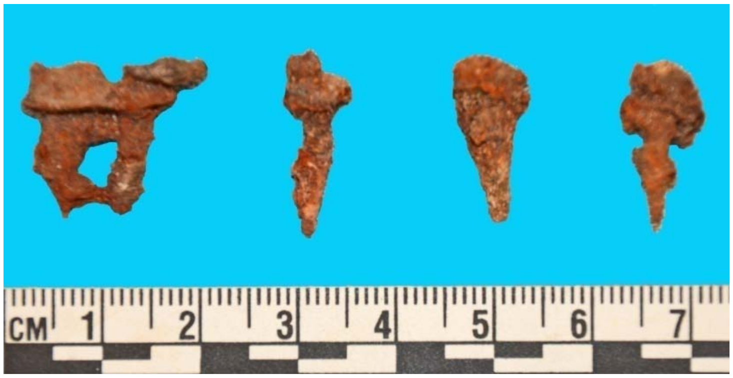


Figure 36. Examples of ferrous tacks recovered from Vault 2.

however, referred to the thickness of the leather the tack was able to clinch. Thus, a 8/16" tack might also be described as a 6 ounce tack.

Their value to us is that they demonstrate that coffins found in the vault had fabric linings, even though no fabric was recovered. Elsewhere Noël Hume does mention this practice briefly (Noël Hume 1969:158).

Figure 37. Brass tacks from Vault 2 in profile.

Also recovered from Vault 2 were 474 brass dome-headed tacks. These historically were measured from under the domed head to the point. They would often be identified by both the diameter of the head, as well as the shank length. We grouped these tacks into three categories. There were only a few with a small head diameter (5/16-inch). Slightly more were in the intermediate category. Most were placed in a large size range that varied, but averaged about ½-inch in diameter.

Similar tacks are briefly mentioned by Stone (1974), where head diameters vary from 9 to 12 mm (⅜ to ½ inch).

Noël Hume is more impressed by these artifacts, describing in more detail their use as decorative items, noting that, "many coffins did not aspire to plates but had the occupant's initials and date of death spelled out in brass furniture tacks on the lid, while their edges and sides were sometimes decorated in floral or geometric tacked designs" (Noël Hume 1969:158). A brief review of but one source (Cox 1998) found that while both ornate use of brass tacks (observed in Figure 6.4) and initials and date (observed in Figure 12.3) occur, far more common was the linear arrangement of tacks (seen in Figures 1.6, 6.2, 6.7, 6.8a, 6.9, 6.10, and 7.3).

The examples of brass tacks on wood fragments from Vault 1 revealed primarily linear designs. There were, however, several that might represent floral designs and letters or numbers. Spacing varies from up to ½-inch (center to center) to tacks actually touching one another. As with Vault 1, the smaller tacks tend to touch each other, while the larger tacks tend to be spaced further apart.

Also recovered were 14 coffin handles and 18 fragments of coffin lugs or backplates. The handles and lugs were heavily corroded because of the burial environment. Although two designs were identifiable, it was not possible to ascertain how many of each type existed.

The first type had handles that measured 4¼-inches in length with drops of 1-inch. The handles themselves are somewhat bulbous and at

Figure 38. Examples of brass tacks attached to coffin wood showing what appear to be designs as well as linear arrangements.

the widest point measure ½-inch in diameter. These were attached to a single lug or backplate measuring 8-inches in length and, at its widest point, 2-inches in height. Ears on each end of the lug were about 2½-inches in height. This style is very similar to the composite sketch obtained for Burials 90 and 176 at the African Burial Ground in New York City (Howson et al. 2009).

The second type of handle seems to be identical in size, although its arms angled upwards. This style of handle was attached to the coffin using two smaller lugs, each with three screws.

Although it is possible that handles have been lost, perhaps as a result of repair efforts, this seems less likely here than in Vault 1 where we saw the comingling of remains. Nevertheless, with five individuals, there is no way to apportion the 14 handles.

It appears there are two options. If we assume that no handles were lost and six handles (three to a side) were used for the adult coffin, then we may have two infant coffins with two handles per side – as we suggested for Vault 1. Alternatively, it is possible (although we have failed to identify supporting documentation) that each of the infant coffins had only two handles – one each at the head and foot.

Unfortunately, the fragments of coffin wood preserved in Vault 2 were not sufficiently intact to allow inferences on the shape of the coffins. Like Vault 1, however, the wood fragments were all identifiable as pine (*Pinus* sp.).

The only other artifacts recovered from Vault 2 are two brass pins. Such artifacts are typically identified as shroud pins (LeeDecker et al 1995:45-46, Loren and Beaudry 2006:261-262), although they are not truly analogous to the specialized shroud pins, often 2½-inches in length,

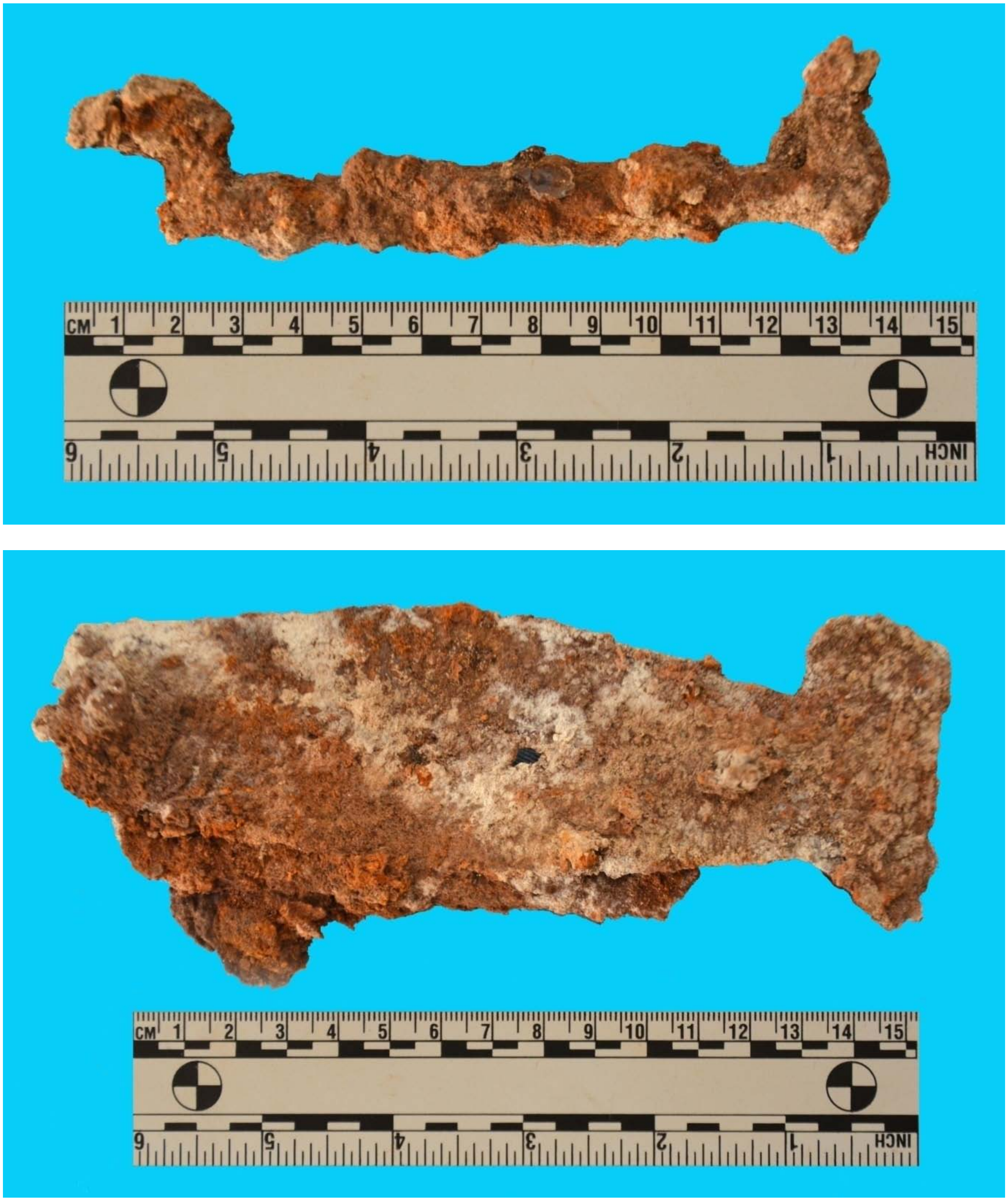


Figure 39. Type 1 handle and lug or backplate from Vault 2.

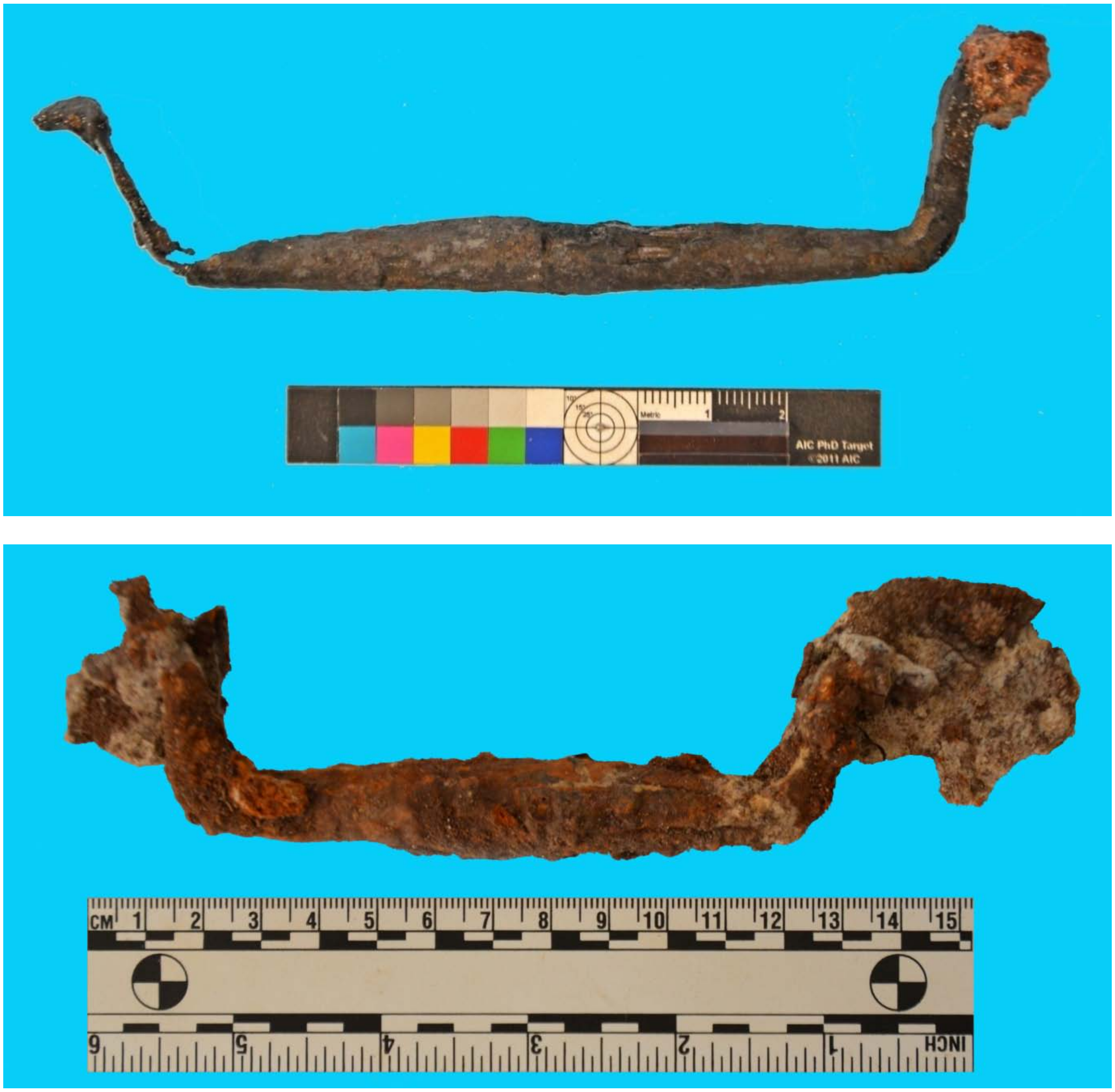


Figure 40. Type 2 handles and lugs from Vault 2.

that are identified in medieval contexts (see, for example, Laing 2006:163-164). Riordan (2009:88-89) suggests that these dressmaker's pins may have been used to secure a face cover or chin strap onto the shroud. The shroud itself would have been tied closed and not pinned.

In Vault 2 these pins were recovered from Section B and measured ⅞ and 1 -inch in length. Both were brass fashioned with wrapped heads and one still revealed silvering.

Radiocarbon Dating

As with Vault 1, lacking name plates or even family tradition, it was impossible to determine when Vault 2 was constructed and used (although the artifacts are eighteenth century). In an effort to resolve that issue a fragment of the wood coffin (identified as such by the attached

Table 9.
Radiocarbon Date of Coffin in Vault 2 (Beta-366743)

Conventional radiocarbon age:	270±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1520 to 1570 and Cal AD 1590 to 1590 and Cal AD 1630 to 1670 and Cal AD 1780 to 1800 and Cal AD 1950 to 1950
1 sigma calibrated results: (68% probability)	Cal AD 1640 to 1650

brass tacks) was submitted for AMS (accelerator mass spectrometry) dating using standard practices by Beta Analytic Radiocarbon Dating Laboratory (Beta-366743).

As with Vault 1, multiple calibration ranges were reported, reflecting "wiggles" in the calibration data in the time range of the Conventional Radiocarbon Age. These wiggles create gaps in the calendar time scale corresponding to the section of the calibration curve which go outside of the precision limitations on the BP date.

Both the one and two sigma calibrated results are shown in Table 9. In some cases it is possible to exclude some of the ranges based on other lines of evidence.

We believe it is reasonable to exclude dates prior to the establishment of Orton (ca. 1727-1730) and to exclude those dates after the sale of Orton out of the Moore family (1778). Ignoring the 1 sigma date ranges in favor of the broader, but potentially more accurate 2 sigma range, we believe the coffin sampled was likely constructed between 1780 and 1800. This places it at the end of Roger Moore's ownership. This seemingly late date may explain why this vault was constructed as a second row, east toward the rice fields.

Skeletal Remains

The skeletal materials in Vault 2 were intermingled and scattered throughout the base of the vault. All remains were in poor condition, fragmented, fragile and worn. These conditions were undoubtedly caused by the intrusion of water during rains, as well as tidal surge from hurricane activity. Due to cracks and holes in the vault itself, there was also considerable animal intrusion over the years; during disinterment fiddler crabs were noticed living in the space. Modern trash found inside the vault was the result of visitors using the roof opening as a convenient trash receptacle.

Identifiable skeletal material was separated and sorted according to size and robusticity. After the sorting, it was determined that there were seven individuals interred in the vault, all sub-adults; no individual retained complete skeletal material.

Individual W

Twenty-one bone fragments were identified as Individual W, an infant. As stated above, the fragments were in poor, fragmented condition, and few measurements were obtained.

No bones evidenced union of epiphyses, indicating age at death of less than 3 years (Baker et.al. 2005: 158); no fusion was evidenced on the occipital fragment, indicating age at death of less than 3 years (Buikstra and Ubelaker 1994: 43). More specifically, the humerus & tibia lengths indicate an age of 6 to 18 months (Ubelaker 1978: 70-71).

Due to the young age of the individual, there was no skeletal evidence to indicate gender; the reliable features of sex determination are developed during puberty (Baker et.al. 2005: 10).

Although an effort was made to retrieve DNA from these remains, none could be obtained. This is the only individual for which a DNA profile could not be determined.

The only indication of abnormality or disease was found in the femurs, both of which were twisted anteriorally at the distal portions,

Figure 41. Vault 2, Individual W.

causing the distal ends to effectively face each other. However, between birth and the age of 8, this rotation usually resolves without intervention. Until the age of 5 years, a child with this condition might walk with toes pointed inwards, but otherwise the rotation is not noticeable (Crane 2008:1).

Individual W appears to be an infant or child between the ages of 6 and 18 months at death, sex unknown. If this child was walking, it likely had a characteristic "pigeon-toed" walk, due to the rotation of the femurs. There was no indication of disease. The bone provided for DNA analysis did not show a maternal relationship with the other individuals in this vault, and the individual is probably not a close relation to the Moore family (Fratpietro 2014a).

Individual X

Twenty-two bone fragments were identified as Individual X, a sub-adult infant. As stated above, the fragments were in poor, fragmented condition, and few measurements were obtained.

No bones evidenced union of epiphyses, indicating age of death at less than 3 years (Baker et.al. 2005: 158); no fusion was evidenced on the occipital fragment, also indicating age at death of less than 3 years (Buikstra and Ubelaker 1994: 43). More specifically, the humerus & tibia lengths indicate an age of 6 to 18 months (Ubelaker 1978: 70-71).

Due to the young age of the individual, there was no skeletal evidence to indicate gender; the reliable features of sex determination are developed during puberty (Baker et.al. 2005: 10).

Portions of the maxilla and mandible were present, with twelve deciduous teeth still in place, eight permanent tooth buds visible in the bone, and eight erupted teeth missing post-mortem.

Tooth development provides a much more reliable, and narrower, age range for infants than does bone development. This individual appears to have been 18 months (± 6 months), or a range of 12 to 24 months at time of death (Ubelaker 1978: 64).

The maxillary, or upper, two central incisors and left incisor have horizontal bands of erosion, or cavities. Given the placement of the erosion lines, the teeth would not have been totally erupted, giving an age of 1 year (± 4 months), or 8 to 16 months at the time of actual erosion (Ubelaker 1978: 64). This is commonly known as baby bottle mouth, and is the result of allowing a baby to fall asleep with a bottle of milk, fruit juice, or sweetened water in its mouth. During the time period this infant lived, bottles were usually used only if the mother was in ill

Figure 42. Vault 2, Individual X, maxilla and mandible, anterior view.

health or otherwise unable to breast feed the infant.

The bone provided for DNA analysis showed a maternal relationship with the Individuals Y1, Z1, and A of this vault, and is likely their sibling, as well as a maternal relationship with Individual A, Vault 1, who may have been her mother. It was also through this DNA profile that it was possible to identify the infant as a female (Fratpietro 2014a).

Individual X appears to be a female infant between the ages of 12 and 18 months at death. Her smile would have been distinctive, showing cavity lines across the four upper central incisors.

Individuals Y1 and Y2

Twenty-two bone fragments were identified as Individual Y, an infant. Because of the poor, fragmented condition of the bones few measurements were obtained. After receipt of DNA results, it became obvious that these were the comingled remains of two infants, referred to now as Individuals Y1 and Y2.

No bones evidenced union of epiphyses and no fusion was evidenced on the occipital fragment, indicating an age at death of less than 3 years (Baker et.al. 2005:158; Buikstra and Ubelaker 1994:43). More specifically, the femur lengths indicate an age of 6 to 18 months (Ubelaker 1978: 71).

Due to the young age of the individual, there was no skeletal evidence to indicate gender; the reliable features of sex determination are developed during puberty (Baker et.al. 2005: 10).

Portions of the maxilla and mandible

Figure 43. Vault 2, Individual Z1, maxillary teeth, anterior view.

were present, with twelve deciduous teeth still in place, four permanent tooth buds visible in the bone, and eight erupted teeth missing post-mortem.

Tooth development provides a much more reliable, and narrower, age range for infants than does bone development. This individual

Figure 44. Modern photograph of "Baby Bottle Mouth" courtesy http://moabdental.wordpress.com/2010/08/14/of-bottles-breasts-and-binkies%E2%80%A6when-your-child-should-stop-part-two/.

appears to have been 18 months (+/- 6 months), or a range of 12 to 24 months at time of death (Ubelaker 1978: 64).

The maxillary, or upper, first right central incisor has a horizontal band of erosion, or cavity, as well as significant decay to the root. The first left incisor is brown, with total root loss, a symptom of severe decay. Given the placement of the erosion line, the teeth would not have been totally erupted, giving an age of 1 year (± 4 months), or 8 to 16 months at the time of actual erosion (Ubelaker 1978: 64). As noted for Individual X, Vault 2, this infant had baby bottle mouth, leading to the death of one tooth.

Figure 45. Vault 2, Individual Y1, maxillary teeth, anterior view.

The DNA analysis of the mandible indicated that this individual, now recognized as Individual Y1, was a female, showed a material relationship with Individuals X, Z1, and A of this vault, and is likely their sibling. There was also a maternal relationship with Individual A, Vault 1, who may have been her mother.

Individual Y1 appears to have been a female infant or child between the ages of 12 and 24 months at death. Her smile would have been distinctive, showing a brown upper incisor; the decay in this tooth may have caused considerable discomfort, resulting in a cranky, crying infant.

DNA analysis of the right femur indicates that this individual, now recognized as Individual Y2, was a male, with no results obtained for the material of paternal association with any individual in this cemetery.

Individual Y2 appears to have been a male infant, between the ages of 6 and 18 months, based on the size and development of the femur and ulna.

Individuals Z1 and Z2

Twenty-two bone fragments were identified as Individual Z, an infant. As stated above, the fragments were in poor, fragmented condition, and few measurements could be obtained. After receipt of DNA analysis, it became obvious that these were the comingled remains of two infants, referred to now as Individuals Z1 and Z2.

No bones evidenced union of epiphyses, indicating age at death of less than 3 years (Baker et.al. 2005: 158); no fusion was evidenced on the occipital fragment, also consistent with an age at death of less than 3 years

Figure 46. Vault 2, Individual Z1, mandible, superior view.

(Buikstra and Ubelaker 1994: 43). More specifically, the ulna length indicates an age of 6 to 18 months (Ubelaker 1978: 70).

Due to the young age of the individual, there was no skeletal evidence to indicate gender; the reliable features of sex determination are developed during puberty (Baker et.al. 2005: 10).

Portions of the mandible were present, with seven deciduous teeth still in place, three permanent tooth buds visible in the bone, and three erupted teeth missing post-mortem.

Tooth development provides a much more reliable, and narrower, age range for infants than does bone development. This individual appears to have been 24 months (± 8 months), or a range of 16 to 32 months at time of death (Ubelaker 1978: 64).

The mandibular right first incisor exhibits wear on the superior edge of the tooth. Possibly the infant favored this side of the mouth for eating, as the left first molar has two deep caries, or cavities, which probably resulted in pain when chewing.

The DNA analysis of the mandible indicated that this individual, now recognized as Individual Z1, was a female, and showed a material relationship with the Individuals X, Z2, and A of this vault, and is likely their sibling. There was also a maternal relationship with Individual A, Vault 1, who may have been her mother (Fratpietro 2014a).

Individual Z1 appears to have been a female infant or child between the ages of 16 and 32 months at death. The decay in the lower left molar may have caused considerable discomfort, resulting in a cranky, crying infant and possible difficulty in eating solid foods.

DNA analysis of the right femur indicated that this individual, now recognized as Individual Z2, was a male, with no results obtained for maternal or paternal association with any individual in this cemetery.

Individual Z2 appears to have been a male infant, between the ages of 6 and 18 months, based on the size and development of the femus, ulna, and radius.

Individual A

Individual A, an adolescent, was identified through 170 bone fragments in poor, often fragmented condition, with several evidencing gnaw marks. Some smaller bones, as found in the hands and feet, were missing postmortem. The occipital bone and two vertebrae were also missing postmortem. The edges of the innominate, rib ends and unfused epiphyses of the long bones were worn and fragmented.

None of the sutures of the cranium were

Figure 47. Vault 2, Individual A, skull. Left is a frontal view, right image is a left lateral view.

fully fused; the maxilla, median palatine suture, zygomatics to maxillae, and zygomatics to temporal were partially fused. Skull fusion typically begins just before the age of eighteen years, and continues past the age of sixty. No evidence of fusion is indicative of an age below twenty years. The vertebrae and humerus distal epiphyses all have complete union, indicating an age of over 13 years (Buikstra & Ubelaker 1994: 38). The right tibia has partial union at the distal end, indicating an age of over 15 years (Bass 1995: 242). The sacral portions are partially closed, indicating an age of over 15 years (Buikstra & Ubelaker 1994: 43). Only the first metacarpals (hands) and first metatarsals (feet) were fused, also indicating an age over 15 years (Baker et.al. 2005: 171). As all other epiphyseal fusing happens between the ages of 14 to 24 years, and none are evident in this skeleton, the age appears to be 15 to 18 years old at death (White 2000: 351).

Because this individual is not an adult, determination of ethnicity is based on morphological variations, not anthropometric measurements, although the measurements have been taken and recorded. The nasal sill, narrow nasal opening, retreating zygomatics and orthognathous (flat) lower face are all indicative of Caucasian, or European, descent (Bass 1995: 88).

Because this individual was an adolescent, morphological indicators of sex are not clear; the reliable features of sex determination are developed during puberty (Baker et.al. 2005: 10). The skull is small and gracile, with moderate supraorbital ridges, rounded frontal profile, faint temporal muscle lines, and small mastoid and supramastoid crest. The gonial eversion is slight, with a slightly pointed chin. The postcranial bones are gracile; the ilium is flared, with a small pelvic inlet and a moderate sciatic notch.

Although the bones are gracile, the lengths of the long bones indicate a maximum stature of 5’5” to 5’6” (Bass 1995: 29).

Figure 48. Vault 2, Individual A. On left is the left femur, frontal view, showing no fusion of epiphyses. On right are the left radius and humerus, frontal view, proximal ends, showing absence of epiphyseal union.

The maxilla and mandible were present, and include all 32 permanent teeth, with the 3rd molars unerupted, indicating an age of fifteen years (± 36 months), or 12 to 18 years at time of death (Bass 1995: 304). The teeth are straight in the jaw, and symmetrically formed.

All incisors showed wear on the edges, exposing a line of dentin on each, indicating heavy biting use.

Multiple caries, or cavities, were present, on seven molars and four premolars; the largest cavities, and likely most uncomfortable, were on the maxillary right first and second molars and left first and second molars. These cavities were only on the buccal surfaces, perhaps from pockets of food being held between the upper cheek and teeth for periods of time.

The sacrum, while partially fused, also exhibits a severe developmental con-genital disorder; the median crest is not fully formed and the dorsal wall is incomplete in all five portions. These are elements that should be complete by the age of twelve to fifteen years (Baker et.al. 2005: 159). The condition in which these elements never develop is called spina bifida occulta (SBO), a mild form of spina bifida, and occurs in 10-20% of the modern population. In this condition, the deformity of the spinal bone is covered by fatty tissue and skin, and can only be diagnosed by spinal x-ray or magnetic resonance imaging (MRI) (Judd 2013: 537).

While this condition is asymptomatic in many cases, there may be neurological problems associated with SBO, including back or leg pain or weakness, or back or leg deformity. Eighty percent of people with SBO have changes to the skin above the deformed area. These visible features are not health hazards and are simply indicative of the underlying defect (Spina Bifida Occulta Health Info Sheet, Spina Bifida Association http://www.spinabifidaassociation.org).

This individual likely suffered moderate to severe back or leg pain or weakness due to SBO (Dr. Talley Parrott, personal communication, 2014). The 1st thoracic vertebra is deformed, with a spinous process twisted to the right; this would have been the result of the upper body consistently twisting to the left. As the individual attempts to function with pain or weakness, he may walk, sit or stand in positions that contribute to further bone deformation in the spine. The left femur is 4mm shorter than the right femur and the left fibula has a sharp spur on the proximal end, perhaps the result of walking with a limp, as well as with a twist in the back or shoulders.

The bone provided for DNA analysis showed a maternal relationship with the Individuals X, Y1, and Z1 of this vault, and is likely their sibling, as well as a maternal relationship with Individual A, Vault 1, who may have been his mother. The DNA profile indicated that the individual was a male (Fratpietro 2014a).

This individual was an adolescent male of European descent, between the ages of 15 and 20 years. He would have had a maximum height of 5’5” to 5’6”, but gracile, with a straight toothed smile. Because of a genetic spinal defect, he likely sat and walked with his back twisted, thrusting his left shoulder down and his right shoulder up and forward, and probably with a slight limp, favoring the right leg.

Figure 49. Vault 2, Individual A, sacrum, posterior view, showing evidence of OSB.

Figure 50. Vault 2, Individual A, 1st thoracic vertebra, superior view.

Vault 3

Vault 3 is situated south of Vault 1 and north of Vault 4, in the northern cemetery area. Its barrel arched roof is similar to Vault 2. When encountered it exhibited extensive deterioration with abundant hard Portland cement mortar patching. In spite of these efforts there was one hole in the roof covered only with Portland cement, as well as many poorly pointed joints. The different qualities of both mortars and repairs suggest at least two, but probably more, repair episodes. This tomb required total repointing and like the others lacks any plaque marking its occupants. Family tradition provided no information on who might be buried in the vault.

Our study revealed that the tomb originally included two individuals, a middle aged to older female and an infant.

There is no institutional history associated with the vault. It is glimpsed in the middle of the Figure 6 photograph, likely from the 1950s. At that time the vault appeared in better condition than we found it 60 years later; thus, it seems that many of the problems occurred in the latter half of the twentieth century and repair efforts used inappropriate materials and techniques. As a result in some areas it become difficult to know how the vault was originally constructed.

Figure 51. Vault 3. Upper photo shows the vault looking west. Lower photo shows an oblique view of the vault looking northeast toward the rice fields.

Construction Details

Vault 3 consists of unreinforced brick masonry side and end walls and a barrel vaulted roof of brick masonry. The overall exterior plan

Figure 52. Vault 3 after pointing and repairs. Upper view shows the vault looking northwest. Lower view shows the vault looking southeast.

dimensions are 6-feet 7-inch wide by 7-feet 10-inches long with side wall heights of 20-inches and an interior height from floor to centerline of the barrel vault of 3-feet 11½-inches. Brick sizes vary and some obviously modern bricks are incorporated into the barrel vault repairs. What appear to be historic bricks average approximately 4-inches wide by 9-inches long by 3-inches tall.

The long north and south side walls are three brick wythes thick (about 12-inches) at their thickest points. Both walls also have two half-wythe recesses. The west and east walls are about 17-inches thick (4 wythes). Interior dimensions are 5-feet 8-inches in length by 3-feet 6-inches in width. The floor is brick masonry and there are four 8-inch knee walls running north-south, each one course in width and height. These divide the interior into five unequal sized spaces. The spaces at the east and west were only 1½-inches and 4-inches respectively. The middle three areas ranged from 14½-inches at the east and west to 9½-inches in the middle.

An interior footer was present in Vault 3, running 19½ -inches up from the floor. One course of this footer was also observed on the exterior of the vault.

The barrel arch is present on the west façade, filled with brick recessed a half-wythe. On the east façade no such arch is present. This suggests that originally access was by way of this west façade.

While no mortar analysis was conducted for Vault 3, where original, soft mortar was encountered, it was visually identical to that reported for Vault 1. Original mortar was not, however, common as the vault had been subjected to at least two repair episodes, including extensive repair of the barrel roof vault. Modern replacement bricks were present, installed with hard Portland cement mortar. Most of this repair appears to be in the

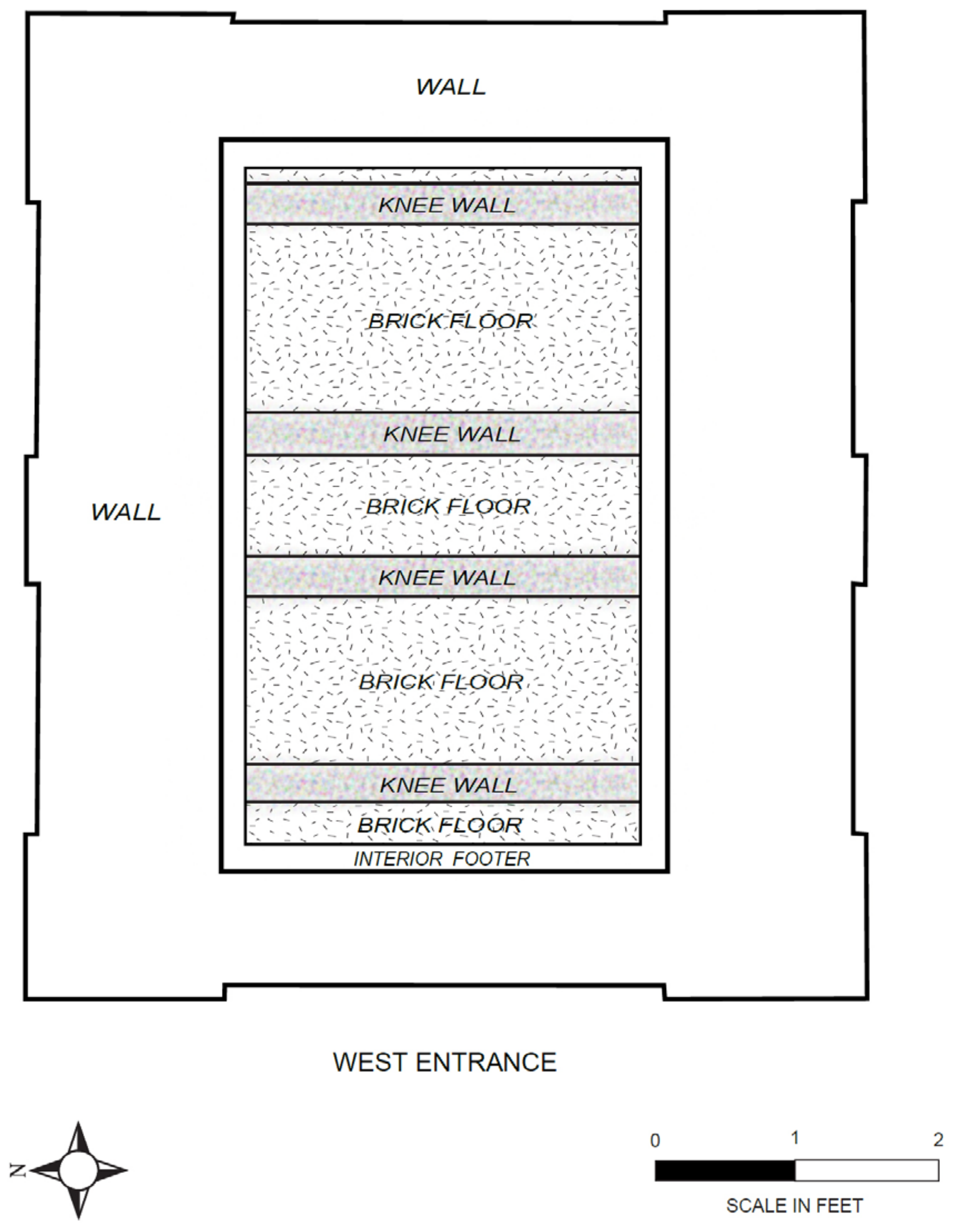


Figure 53. Vault 3 plan.

Figure 54. Interior of Vault 3. Upper view is the opening on the west end. Middle view is the interior of vault looking east. Lower view shows the debris on the floor.

western half of the roof.

Field Procedures

Upon opening the west entrance, we observed a floor consisting of brick and mortar rubble, a few fragments of recognizable wood, and occasional bone fragments. The knee walls were observed, but we did not initially realize that there was relatively little deposition in the vault.

The debris was removed from the vault by knee wall section, identified from west to east as A, B, and C. The very narrow sections at the east and west ends were not given their own designations, but were incorporated with the adjacent section.

For the most part the soil was homogenous and the deposits were very thin – only 2-inches – thus allowing the knee walls to be visible. This soil was a dark brown sand. The exception to this was in the last tier, adjacent to the east wall. There we observed soil and sand that appeared to have been washed into the vault. This may be the result of the vault being left open for some period, perhaps during a repair episode.

Readers will recall that we explained remains from Vault 3 had been removed and deposited in Vault 1 during a repair episode. This, we believe, explains the very limited deposition in Vault 3 (as well as the low density of artifacts).

The bulk of the wood identified in the vault was modern and used for a significant arch repair in the western portion. Visible on the interior was a sheet of plywood wedged in the roof used to support

Figure 55. Plywood on the interior vaulted roof used in a twentieth century repair effort.

the brick repair.

All fill was screened through ¼-inch mesh. We found that the rubble to soil ratio (by volume) was 8:1. Thus, while there was organic soil that we presume was formed from decomposition and perhaps minor storm flooding, most of the fill consisted of mortar debris, from either the original construction or the various repair episodes.

Figure 56. Vault 3 floor after excavation looking east.

The floor in Vault 3 was poorly laid, using brick fragments. Some brick were missing, although this may be the result of repair efforts.

In this one vault several flooring bricks were removed to examine the underlying soil (about 2-feet below grade). We found a loose, white sand with small fragments of brick rubble (ranging from 2-inches to less than an inch). There is no horizon of white sand in the typical Blanton soil profile, so this may be a small pocket of another soil intermingled on the point. The presence of the brick rubble is likely the result of construction activities, consistent with placing the floor after the walls were constructed.

The knee walls were constructed on top of this floor and abutted the north and south walls (although in several cases the knee walls were so poorly built that there was a gap at the wall up to a ½-inch). The distance between the walls is not uniform as previously discussed. In addition, the heights of these walls varied by about ½-inch, suggesting little care in their execution. As elsewhere, we believe the function was to prevent coffins from sitting on the

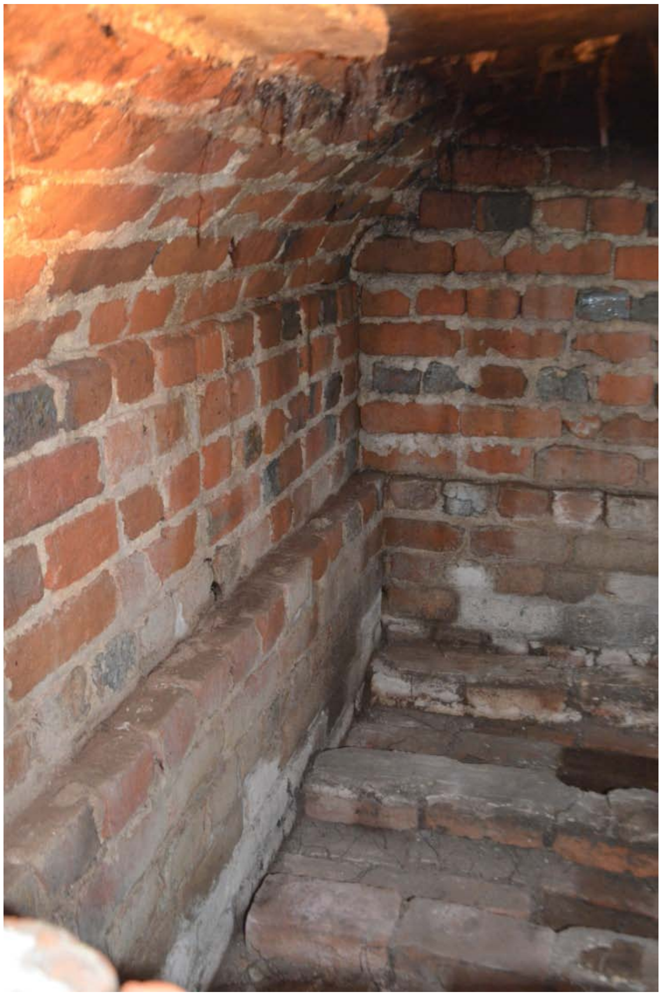


Figure 57. North and east walls of the vault after excavation, looking northeast.

vault floor. It is also possible that these knee walls were reduced in height during the repair efforts as some mortar was found on top of the walls.

Unlike Vaults 1 and 2, no lumps of mortar were found on the floor of Vault 3. It may be that the knee walls were sufficient to support the coffins.

The fragments of modern wood appeared to be supports, intended to hold the plywood in place while the bricks and mortar were set. The plywood remains intact in the ceiling since it was partially encapsulated by mortar. The supports, in contrast, rotted and collapsed. This wood was discarded.

As will be discussed in our analysis of the human remains, only a few remains were found in the fill; most of the bones and associated artifacts had been removed to the southeast corner of Vault 1.

Artifacts

The artifacts recovered from the interior of Vault 2 are itemized in Table 10. All artifacts except the 45 modern items are being reinterred with the human remains.

Modern Specimens

A number of clearly modern artifacts were recovered from Vault 3. These included 19 machine nail fragments and one intact machine cut nail 2½-inches in length (8d); eight brass eyelets, probably from footwear; 10 fragments of what appear to be strap metal, although conceivably they might be remnants of coffin hardware; four paper shotgun shells; one wire nail, and two coal fragments.

All of these are consistent with a late nineteenth to early twentieth century time frame. For example, the paper shotgun shells likely pre-date about 1960, after which paper cartridges were rapidly replaced by plastic shells (Barnes 1993:384). Nelson (1968) and others (e.g., Adams 2002) note that while wire nails were available in the mid-nineteenth century, they were not dominant until the early twentieth century. The machine cut nails post-date the 1840s and continue to be used today.

It seems likely that all of these items were introduced to the vault either while the vault was open or during repair efforts. It's possible that the open vault was seen as a convenient receptacle for trash disposal.

This vault also produced a very large number of animal bones. Many are commensal species, such as rodents and snakes. The former

Table 10.
Artifacts Recovered from Vault 3

	Section A	Section B	Section C	Total
Ferrous tacks, 11/16", flat head	5	4	6	15
Brass tacks, large, .48-.53" (8/16")	2		3	5
Brass tacks, medium, .39-.42" (3/8 - 7/16")	8	5	3	16
Brass tacks, small, .32" (5/16")	2	2	1	5
Animal bones	102	31	48	181
Modern Materials				
Machine cut nail fragments	10	4	5	19
Machine cut nail, 2½"	1			1
Brass eyelets			8	8
Strap metal		4	6	10
Paper shot gun shells	2		2	4
Wire nail	1			1
Coal frags	2			2

are drawn to the vaults for shelter and nesting, the latter drawn to the vaults by the presence of the rodents as a food source. Others, however, are more difficult to explain. For example, we recovered a number of fish remains, including catfish. It may be that these remains indicate the open vault also harbored raccoons, who deposited the fish bones.

Burial Artifacts

There were 41 specimens, not including wood fragments, associated with Vault 3 – indicating that the effort to clean out Vault 3 was thorough.

There were 15 ferrous tacks, all measuring 11/16-inch, within the range observed from Vault 1.

We have previously discussed such tacks in the context of Vaults 1 and 2 and those discussions should be reviewed for additional information. Their presence in Vault 3 helps confirm that the coffins here were similar to those identified from the other vaults and included fabric linings.

Also recovered from Vault 3 were 26 brass dome-headed tacks. These, too, have been discussed elsewhere in detail. Most (16) were a medium size head (⅜ to 7/16-inch), with minor amounts of both larger and smaller tacks. While several were found with attached wood, all were individual tacks and it was impossible to determine what, if any, designs were present.

No other remains, such as coffin handles, were recovered – so we assume they were gathered up and deposited in Vault 2.

The wood fragments present were too fragmentary to allow species identification and all were submitted for radiocarbon analysis (discussed below).

Radiocarbon Dating

Lacking any other mechanism for dating, we submitted the fragmentary wood thought to be associated with coffins for AMS (accelerator mass spectrometry) dating using standard practices by Beta Analytic Radiocarbon Dating Laboratory (Beta-369868). The use of multiple fragments may mean that the date reflects wood from several coffins and may thus be an "average" of the two burials known to have originated in this vault.

As elsewhere, multiple calibration ranges were reported, reflecting "wiggles" in the calibration data in the time range of the Conventional Radiocarbon Age. These wiggles create gaps in the calendar time scale corresponding to the section of the calibration curve which go outside of the precision limitations on the BP date.

Both the 1 and 2 sigma calibrated results are shown in Table 11. In some cases it is possible to exclude some of the ranges based on other lines of evidence.

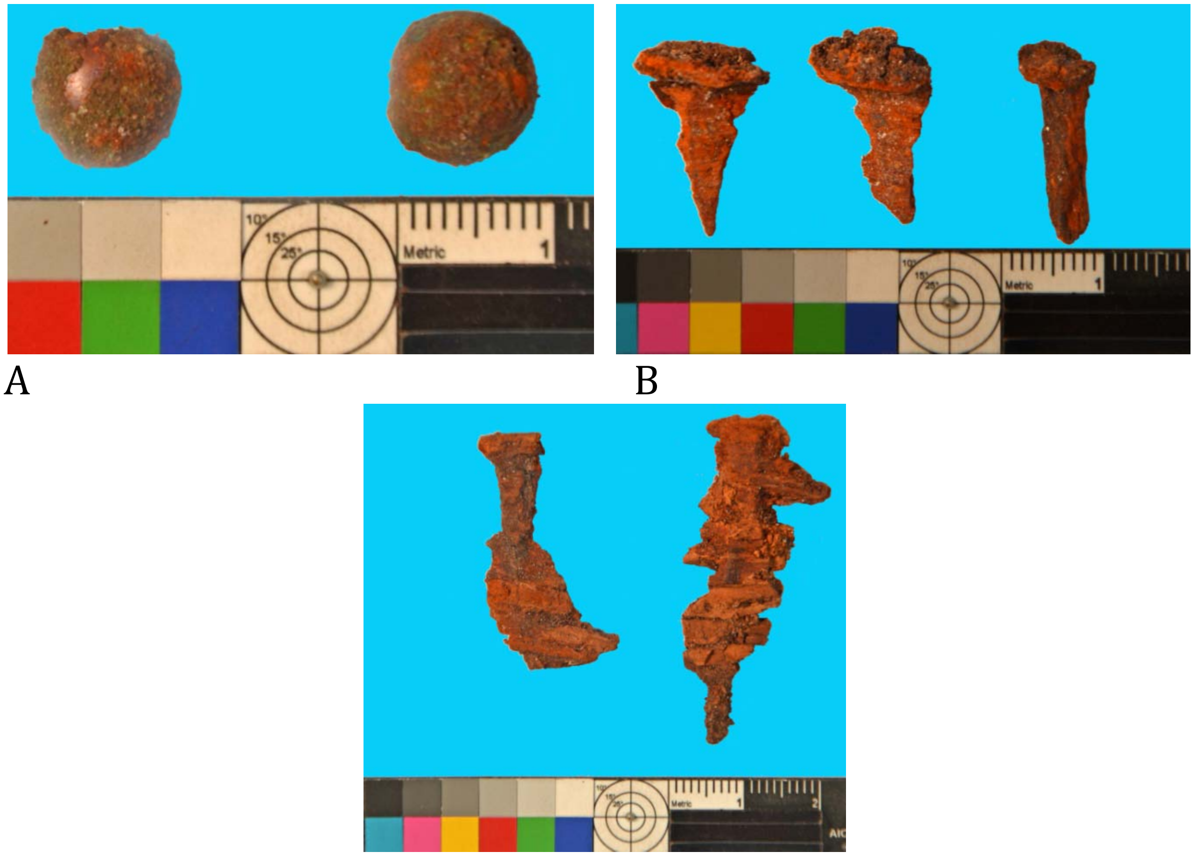


Figure 58. Artifacts recovered from Vault 3. A, brass tacks; B, ferrous tacks; C, machine cut nails with adhering wood.

We believe it is reasonable to exclude dates prior to the establishment of Orton (ca. 1727-1730) and to exclude those dates after the sale of Orton out of the Moore family (1778). Ignoring the 1 sigma date ranges in favor of the broader, but potentially more accurate 2 sigma range, we believe the coffin sampled was likely constructed between 1780 and 1800. This places it at the end of Roger Moore's ownership. The radiocarbon date for the wood is also identical to that obtained from Vault 2, suggesting that the two are roughly contemporaneous. Since this seemed unlikely and may have resulted from the fragmentary wood available, we chose to submit a second sample of bone, in order to better date the burial of the adult from Vault 3.

These dates, shown in Table 12, provide

Table 11.
Radiocarbon Date of Coffin in Vault 3 (Beta-369868)

Conventional radiocarbon age:	270±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1520 to 1570 and Cal AD 1590 to 1590 and Cal AD 1630 to 1670 and Cal AD 1780 to 1800 and Cal AD 1950 to 1950
1 sigma calibrated results: (68% probability)	Cal AD 1640 to 1650

Table 12.
Radiocarbon Date of Burial A in Vault 3 (Beta-372928)

Conventional radiocarbon age:	160±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1665 to 1710 and Cal AD 1720 to 1890 and Cal AD 1910 to Post 1950
1 sigma calibrated results: (68% probability)	Cal AD 1670 to 1690 and Cal AD 1730 to 1780 and Cal AD 1800 to 1810 and Cal AD1920 to Post 1950

refinement, but both the 1 and 2 sigma date ranges cover the entire Moore occupation of Orton Plantation. Consequently, absent additional genealogical data, these radiocarbon dates do not provide sufficiently tight dating to help better determine when the vault was constructed and the burials took place.

Skeletal Remains

The skeletal materials in Vault 3 represented only partial remains from a sub-adult infant and an adult female. These remains were in poor condition, fragmented, fragile, and worn. These conditions were at least partially caused by the repair work that had taken place in this vault.

Identifiable skeletal material was separated and sorted according to size and robusticity. After the sorting, it was determined that these remains mended and matched two individuals found in Vault 1 and identified as individuals B and Z. At some point the identifiable remains from Vault 3 were collected, removed from the vault, and temporarily stored with remains already in Vault 1. The remains were never returned until these investigations, at which time all the associated remains of individuals B and Z have been returned to Vault 3.

Individual B

Seventy-five bone fragments were identified as Individual B, an adult female. The bone was in very poor, fragmented, cracked, gnawed and eroded condition. Five bones attributed to this individual, as well as two bones attributed to Individual Z, were located in Vault 3; the left ilium of Individual B was also damaged post-mortem, with deep cuts on the iliac crest, possibly from a shovel.

Due to the fragmentary nature of these bones, only fourteen post-cranial epiphyseal areas were noted, and all had complete union, indicating an age over thirty years (Buikstra and Ubelaker 1994: 42). All ectocranial sutures were open, indicating an age of 22 to 45 years (Buikstra and Ubelaker 1994: 38). The auricular surface of the ilium ranks as a Phase 6, with a partially granular surface, some densification of the surface, and slight changes in the apex, indicating an age of 40 to 44 years (Buikstra and Ubelaker 1994: 25). No dentition was recovered, so no information was available for further aging of the remains. Given the markers available, this individual appears to have been 40 – 45 years old at death.

Only the left ilium and small fragments of the right ilium were recovered, and a deep, wide sciatic notch was evident. The occipital portion of the skull had only a minimal expression of bony projection, or nuchal crest. The mandible had a moderately pointed chin, with little projection of the mental eminence. These morphological characteristics indicate that this individual was female (Bass 1995: 86, Buikstra and Ubelaker 1994: 19).

Determination of ethnicity is based on the measurements and morphology of the facial portion of the skull. Because all of the facial bones are missing postmortem, determination could not be made; however, given that all other individuals in the cemetery were of Caucasian, or European, descent, it is likely that she was as well.

The sacrum is fragmentary, but shows no evidence of spina bifida occulta.

No cervical vertebrae were recovered. Only one thoracic and two lumbar vertebrae were

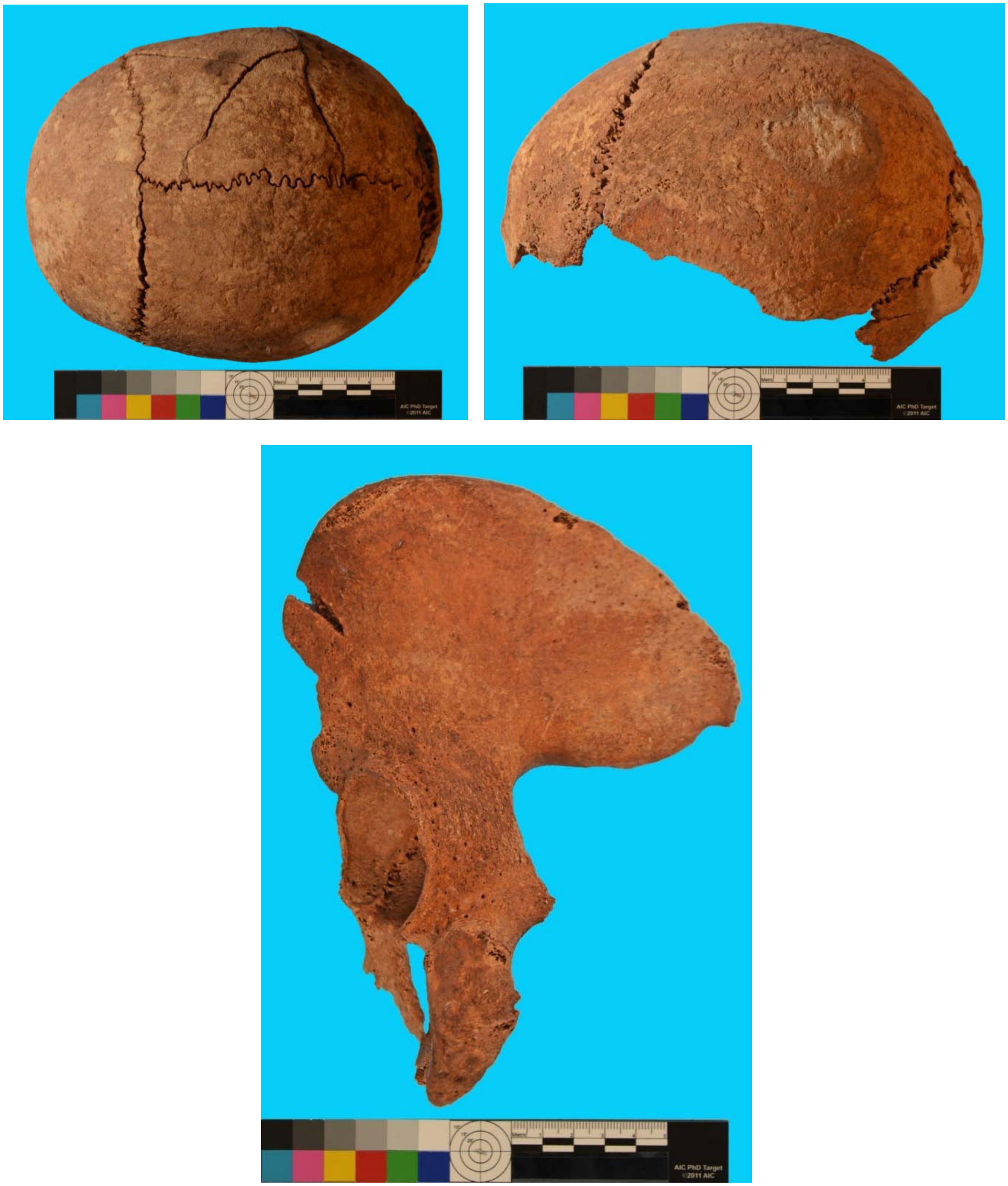


Figure 59. Vault 3, Individual B. Upper left photo shows a superior view of the cranium. Upper right photo shows dorsal (left) view of the cranium. Lower photo is the interior of the left ilium.

Figure 60. Vault 3, Individual B. Upper photo is a posterior view of the sacrum. Lower left is a superior view of the 5th lumbar vertebra. Lower right photo shows an inferior view of the 5th lumbar vertebra.

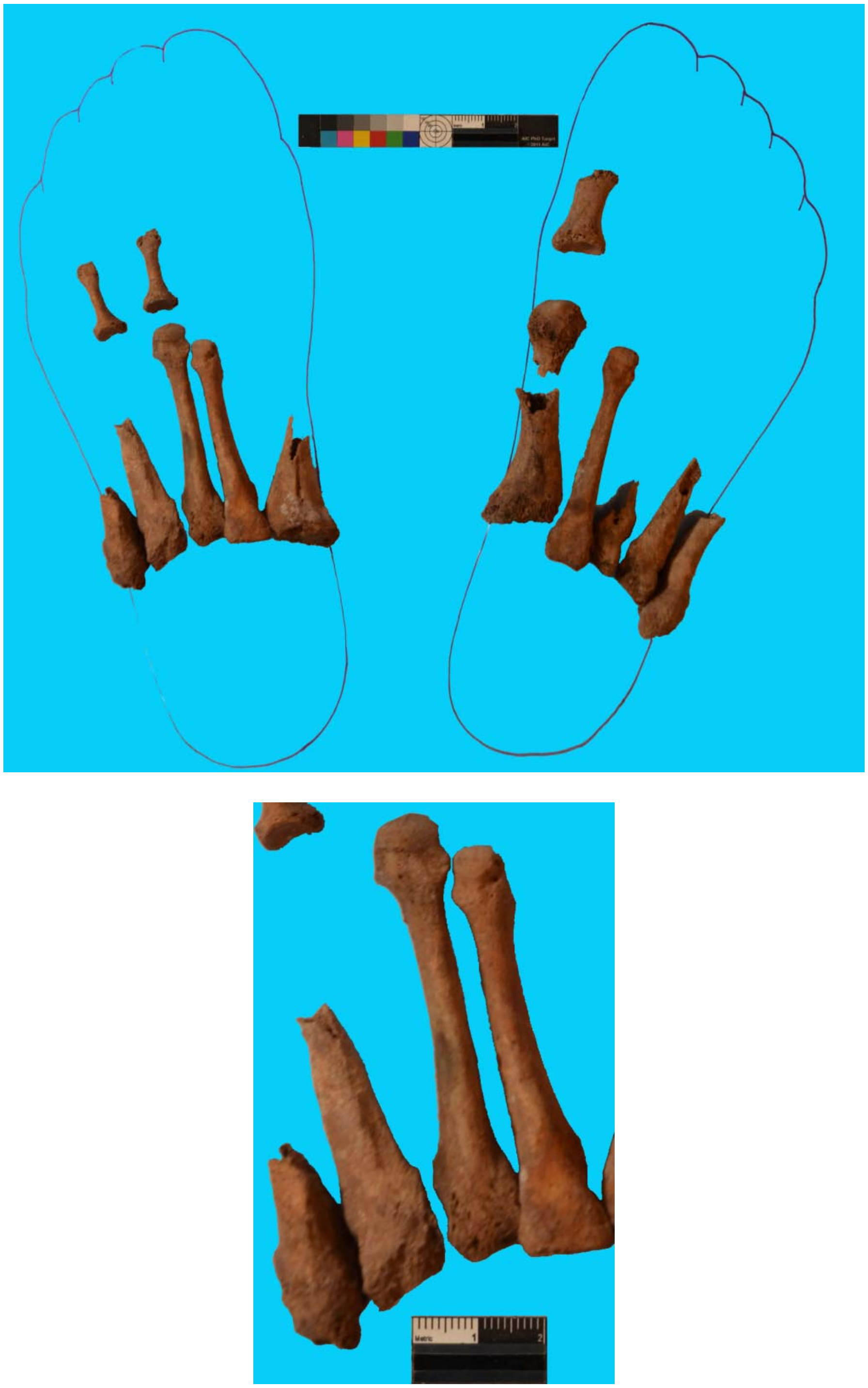


Figure 61. Vault 3, Individual B. Top photo is a superior view of the metatarsals and phalanges. Bottom photo is a close-up of the left metatarsals, superior view.

recovered. All thoracic and lumbar vertebrae had moderate lipping, porosity and osteophytes on inferior and superior bodies. This is evidence of moderate osteophytosis, or the degeneration of intervertebral disks, a symptom of osteoarthritis. As the intervertebral disks degenerate, the vertebral bone on either side begin touching; as a reaction to the bone contact, the body creates a protective barrier of bone, or osteophytes on the inferior and superior aspects of the vertebrae. As the condition continues, the osteophytes can develop from spurs to lipping (Steele and Bramblett 1988: 136). The porosity and pitting of the vertebral bodies is also seen as a result of osteoarthritis (Aufderheide and Rodriguez-Martin 1998: 97).

This individual may have suffered mild back pain due to osteoarthritis in the spine. Because so many vertebrae were missing post mortem, it is impossible to determine whether this altered her spinal shape or posture.

The only long, or limb, bones intact for measurement were the right and left femora. At 472.0 and 475.5mm respectively, this indicates a maximum height of 5'6" to 5'7" (Bass 1995: 29).

The right calcaneus evidenced lipping on the articular surface for the talus, as well as osteophytic growth on the posterior inferior, or heel, portion. The right tibia had lipping of the medial malleolus. The right fibula had lipping on the malleolar fossa. All of these indicate arthritic changes of the right leg and ankle, probably causing mild to moderate discomfort. There are no extant bone fragments for left leg comparison.

The complete metatarsals of the left and right feet show bony alterations on the superior distal surfaces. Combined with the osteophytic growth on the right tibial tuberosity, this indicates prolonged kneeling by the individual (Ubelaker 1979: 679).

The bone provided for DNA analysis showed this was a female of European descent, with no maternal relationship with any other individuals recovered (Fratpietro 2014b).

To determine if this individual was Catherine Rhett, an effort was made to identify living matrilineal descendants in the Rhett line. One was tentatively identified and agreed to a DNA test suitable for comparison with Individual B. In a surprising turn of events, we discovered that the DNA of this living individual was not a match to Individual B, but was a match to the DNA obtained from Individual A in Vault 4, which subsequent discussions will reveal to be that of Roger Moore. Consequently, there is either some error in the genealogical assignment of this living individual or there has been some unrecognized familial intermarriage in past generations.

Unable to identify another living relative, we are therefore unable to ascertain if Individual B is Catherine Rhett, although she remains the best explanation for the identified materials.

In summary, this individual was an adult female of European descent, between the 40-45 years old at death. Her maximum height would have been between 5'6" and 5'7". She appears to

Figure 62. Vault 3, Individual Z. Superior view of the mandible showing teeth development.

have spent a significant amount of time in a kneeling position, as well as walking and standing. She may have suffered mild to moderate discomfort from arthritis in her back and ankles. She was not maternally related to any other individuals in the cemetery, and may have been Roger Moore's second wife, Catherine Rhett Moore.

Individual Z

Three bone fragments were identified as Individual Z, a sub-adult infant. As stated above, the fragments were in poor, fragmented condition, and few measurements were obtained.

The bone fragments were identified as fragments of the right femur (minimum length 98.8mm), left femur (minimum length 97.0mm), and a portion of the mandible. The distal end of the right femur showed no epiphyseal union, indicating age of death at less than 3 years (Baker et.al. 2005: 158). The femoral fragment minimum lengths suggest an age of 6 to 18 months (Ubelaker 1978: 70-71).

Tooth development provides a much more reliable, and narrower, age range for infants than does bone development. Only three deciduous teeth were found: 61m2 (mandibular left 2nd molar), 69m1 (mandibular right first molar) and 70m2 (mandibular right 2nd molar). 61m2 and 69m1 were fully erupted, 70m2 was not, suggesting an age of 24 months (+/- 8 months), or a range of 16 to 36 months (Ubelaker 1978: 64). Neither of the erupted teeth showed any wear or damage. There were also four tooth buds for permanent teeth.

The bone provided for DNA analysis showed that this infant was female, but did not share a maternal relationship with the other individuals in this cemetery. DNA also noted that this individual was of European descent (Fratpietro 2014b).

In summary, Individual Z appears to be a female infant between the ages of 16 and 20 months at death. There was no indication of disease or injury. She was not maternally related to any other individuals in the cemetery.

Vault 4

Vault 4 is situated in the middle of the cemetery at the south end of the row of vaults and just north of the burials of more distantly related family members. It is similar to Vault 1 in that it has a gable roof although it possesses a west facing arched opening similar to Vault 3. When encountered, the vault exhibited heavy biologicals as well as multiple repairs using a hard ordinary Portland cement (OPC). As a result some bricks were badly deteriorating, others had been entirely lost with OPC infill. Most of the joints were either open or had been filled with OPC mortar. As a result, the tomb required total repointing. The tomb is unmarked and family legend provided no information on who might be buried in the vault.

Figure 63. Vault 4. Upper photo shows the vault after pointing looking northeast. Lower photo shows the vault looking northwest.

Although the tomb is visible in both of the early photographs of the cemetery (see Figures 5 and 6), there is no institutional history associated with the vault. The early photographs suggest the vault was in generally good condition and certainly did not suffer the damage observed for Vaults 1, 2, and 3. Historically, attention has been directed to the largest vault at the north end of the line (Vault 1) as the presumptive burial location of Roger Moore and Vault 4 has attracted very little attention.

Our study revealed that the tomb included a single male, aged between 44 and 63. This research demonstrates that the remains in Vault 4 are almost certainly those of "King" Roger Moore, buried in 1751.

Construction Details

Vault 4 consists of unreinforced brick masonry side and end walls and a gable roof of brick masonry. The overall exterior plan dimensions are 7-feet 1-inch wide by 9-feet 4-inches long with side wall heights of 2-feet 2-inches and an interior height from floor to centerline of the vault roof of 4-feet 3-inches. The interior roof is not gabled, but rather arched, suggesting that the gable consists of a second course of brick resting on the supporting arch. Brick sizes vary but average approximately 4-inches wide by 9-inches long by 3-inches tall.

The long north and south side walls are three brick wythes thick (about 12-inches) at their thickest points. Both walls also have two half-wythe recesses. The east and west walls are also three brick wythes thick (about 12-inches). The east wall has two half-wythe rectangular recesses. Interior dimensions are 7-feet 3-inches in length by 4-feet in width. The floor is brick masonry and there are three 6½-inch high knee walls running north-south that divide the interior into four spaces that ranging from 5½-inches at the east end, 2-feet in the two middle compartments, and 9-inches at the west end. Each wall was built after the vault was floored and all are one brick wythes thick.

The top of the arch at the west end above grade is 2-feet 11-inches and the drop from the ground surface to the interior vault floor is 1-foot 10-inches.

Mortar Analysis

Two samples were submitted for analysis, one from the west side within a deep joint that produced relatively soft, light gray mortar and another from the south side where a light gray stucco was obtained.

Petrographic Examination

The paste in both samples appears to consist of hydraulic hydrated lime. Residual grains of a natural cement were not detected. The paste color in both samples is light gray. Residual grains of portland cement were not detected. The hydrated lime appears to be a dolomitic type; it may likely be a hydraulic type. Evidence of slaked lime putty was found in both samples.

In both samples, the paste is moderately soft and is carbonated. The paste aggregate bond and the mortar firmness appear weak in both samples. The degree of hydration is advanced. A few pockets of dispersed hydrated lime are present. Lumps of slaked lime were detected in both. Secondary calcium carbonate is present. Brick fragments are present, at a low amount on the mortar sample. The stucco sample is harder and more firm than the mortar sample.

The aggregate in both samples is a natural sand with a 1.1 mm maximum grain size and a modal grain size of approximately 0.27 mm. The particle grading appears slightly finer than the natural sand grading specified in ASTM C144 (aggregate for masonry mortar). The sand consists of quartz, orthoclase feldspar, and a low amount of limestone. The aggregate is in a physically and chemically stable condition. The sand content appears very high in the mortar sample, and low in the stucco sample.

In both samples, the mortar is not air-entrained, and has a normal entrapped air content of approximately 7.0 to 10.0%. The majority of air voids are irregular in shape, and appear entrapped.

Chemical Analysis

The binder in the mortar appears to consist of dolomitic hydrated lime, which may be hydraulic. The paste in both samples is carbonated. Brucite (magnesium hydroxide) was detected at a moderate amount in both samples, indicating the hydrated lime is an impure, dolomitic type. The binder in both samples appears to consist of hydrated lime.

The hydrated lime in both samples was estimated to contain 10.0% soluble SiO_2; 38.7% calcium oxide (CaO); and 26.1% magnesium oxide (MgO), which is equal to 37.8% brucite ($Mg(OH)_2$).

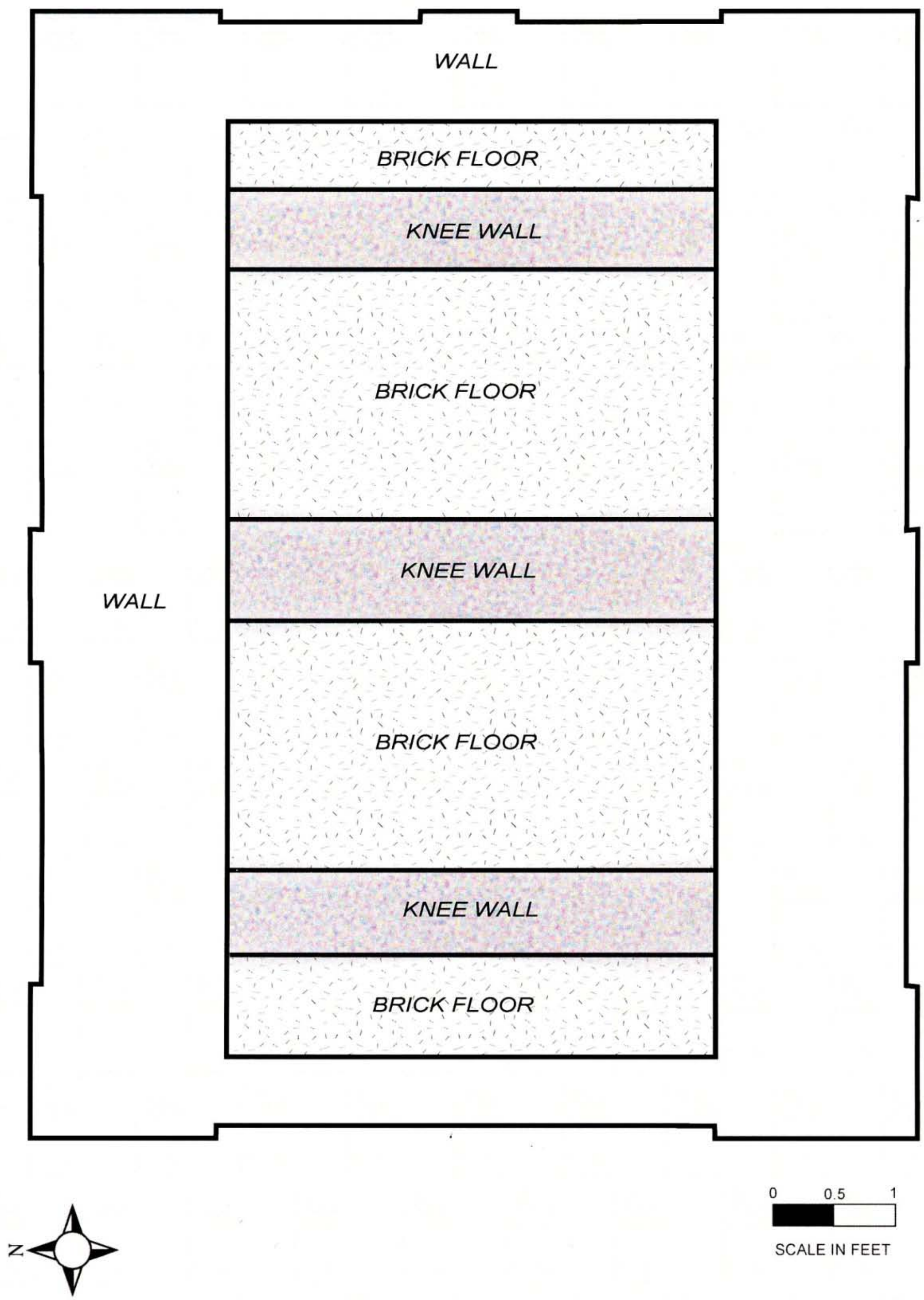


Figure 64. Vault 4 plan.

Table 13.
Mortar and Stucco Composition

Constituent	Mortar	Stucco
silica (soluble SiO_2)	1.43	2.23
calcium oxide (CaO)	16.60	19.01
magnesium oxide (MgO)	3.76	5.80
brucite ($Mg(OH)_2$)	5.38	8.44
insoluble residue	76.13	66.90
Loss on Ignition (% by mass)		
at 0-110° C - free water	0.11	0.07
at 110-550° C - hydrate water	3.23	4.33
at 550-950° C - CO_2	5.70	7.33
Calculated Constituents (% by mass)		
hydrted hydraulic lime	14.30	22.30
fine aggregates (sand)	82.40	73.30

The hydrated lime was calculated based on the amount of brucite. Brucite content was quantified using Differential Scanning Calorimetry (DSC) – Thermal Analysis.

Since a low amount of limestone was detected in both samples, the aggregate contents were calculated by difference: 100.0% minus the sum of: free water plus hydrated water and hydrated lime.

The densities (loose volume basis) of the mortar ingredients were assumed to be those listed in ASTM C270. Eighty lbs. of dry sand was assumed to be equal to one cubic foot of damp loose sand. Hydraulic lime putty is estimated at 100 lbs./ft.^{3}, consisting of 50% free water and 50% hydrated lime (calcium hydroxide). However, the hydrated hydraulic lime was assumed to have a bulk density (loose) of 50.0 lbs./ft.^{3}, which is higher than the 40.0 lbs./ft.^{3} specified in ASTM C270.

Both mortar samples appear to be a hydrated hydraulic lime and sand mix.

The volumetric proportion of the mortar sample (determined according to ASTM C270) is 1 part hydrated hydraulic lime to 3.6 parts natural sand. The proportion of the stucco is 1 part of hydrated hydraulic lime to 2.05 parts natural sand. Thus, for the mortar sample, sand content is high, while sand content is low in the stucco.

Based on the chemical analysis results, the mortar and stucco samples do not conform to any proportion type specified in ASTM C270. They both appear to be hydrated hydraulic lime with fine sand.

Field Procedures

Upon opening the west arched entrance, we observed the best preserved remains of any vault, with an extended skeleton that appeared nearly intact lying on the south side of the vault. It appeared that the coffin has been placed in the vault leaving room for a second to be placed to the right or north. There was very little rubble or mortar fall. Wood that appeared to be coffin remains had fallen away from the skeleton to the north and south. The brick dust present over all of the remains was the result of our opening the vault. There was little evidence of soil in the vault and the knee walls were distinct.

With the remains so undisturbed, we elected not to remove materials by sections, but rather first documented the skeletal remains and then removed them, wrapping items in clean newsprint and labeling the different elements. Hands, feet, and ribs were bagged by side. The vertebra were removed by section.

Once the remains had been removed, a soil sample was collected from the thoracic region for additional analysis. This sample was carefully dry screened through ⅛-inch mesh for any artifacts before being bagged.

The remaining soil, which was about 0.1 foot in depth, was collected and screened through ⅛-inch mesh for artifacts. We found that the rubble to soil ratio was about 1:20, indicating that almost no damage to the vault had occurred during its history and previous repairs were

Figure 65. Vault 4. The upper photo shows the skeletal remains visible when the vault was opened. The lower photo shows working conditions in the vault.

entirely cosmetic, consisting of pointing and concrete smears on the exterior.

The floor in Vault 4 was almost identical to those seen in the other tombs. A combination of whole and partial bricks was roughly laid at the base of the vault, with the knee walls then built directly on the floor. As elsewhere, the placement of the knee walls appears to have been rather unimportant and only minor effort was made to space them evenly. All of the knee walls are two courses in height, or about 6½-inches. As elsewhere, we believe the function was to prevent coffins from sitting on the vault floor.

Unlike Vaults 1 and 2, we found no piles of lime mortar on the floors.

The west entrance of the vault did contain bricks that did not appear to be original to the construction. This is a possible indication that the vault was opened at some point, although it is possible that a few different bricks were incorporated into the original construction. Regardless, if the vault was opened, it was likely quickly closed again since we have no evidence of disturbance.

Unlike vaults where there had been repair efforts, we found no indication of any wood other than that associated with the coffin.

There are, however, wood impressions in the roof mortar, indicating that supports for the arch were present at least during the original construction. The failure to find any remains suggests that they were removed prior to placing

Figure 66. Interior vault construction details. Upper left photo shows the knee walls and floor along the south edge of the vault. Upper right photo shows the opened west end of the vault (note darker bricks forming a portion of the original end wall). Lower photo shows the arched brick ceiling.

Figure 67. Wood impression in the ceiling mortar.

the coffin in the vault.

Artifacts

The artifacts recovered from the interior of Vault 4 are itemized in Table 14. All artifacts are being reinterred with the human remains.

Unlike Vaults 2 and 3, which exhibited extensive repair episodes, Vault 4 produced no modern artifacts – providing further evidence that the tomb had not been entered during the late nineteenth or early twentieth centuries.

Burial Artifacts

There were 350 specimens, not including wood fragments or animal bones, associated with the one adult burial from Vault 4.

These included 111 nails or nail fragments. Seventy-one nail fragments were too corroded and fragmentary to further identify. Forty nails, however, were identifiable as hand wrought – 11 of these were 2-inches (6d) and the remaining 29 nails were 2½-inches (8d) in length. These sizes are consistent with sizes typically associated with the construction of coffins and we anticipate that all of these were used in the construction of the one coffin found in Vault 4.

The absence of nails that might be associated with the arch to support the brick roof is a further indication that all of this wood form work was removed prior to the use of the vault.

There were 11 ferrous tacks, all measuring 5/16-inch; the smallest size found in the Orton vaults. The low incidence is likely the result of loss through corrosion.

Table 14.
Artifacts Recovered from Vault 4

	Total
Nail fragments	71
Nails, Hand Wrought, 2"	11
Nails, Hand Wrought, 2½"	29
Ferrous tacks, 5/16"	8
Ferrous tacks, 9/16"	
Ferrous tacks, 5/8"	
Flat iron, lug fragments	222
Large Handles	5
Small Handles	1
Brass tacks, medium, .39-.42" (3/8 - 7/16")	1
Straight pin, ¾"	1
Straight pin, 1"	1

Figure 68. Artifacts from Vault 4. Upper left shows wrought tacks. Upper right is a heavily corroded brass tack. Lower image is coffin wood showing angle at shoulder.

We have discussed elsewhere that tacks are given rather limited discussion in most archaeological studies. Jobe (1987:72) notes, however, that prior to about 1790, tacks were made of hand forged shanks with hammered heads – similar to nails – and cut shanks weren't introduced until about 1780. While heavily corroded, all of the tacks identified from Vault 4 appear to be wrought examples, indicating a relative early date for their manufacture.

The value of these tacks, however, is not for their modest dating ability, but rather because they demonstrate that the coffin found in the vault had a fabric lining, even though no fabric was recovered. We have previously discussed this practice, noting that the lining found in one coffin from Vault 2 was very finely made.

Unlike all of the other vaults at Orton, this one yielded only a single brass tack and this specimen was very heavily corroded. We have explored the use of decorative brass tacks found in the other vaults. While often used to indicate names and dates, most of the tacks on other coffins seemed only to reveal banding along the sides and lids of the coffins. Unfortunately, the one extant example from Vault 4 cannot contribute to this discussion.

While it is possible that preservation in Vault 4 was substantially less than occurred elsewhere, it seems more likely that the coffin in this vault received far less decoration than those found in other vaults.

Also recovered were six coffin handles and 222 fragments of coffin lugs or backplates. All were heavily corroded and the lugs were extremely thin and fragile. Nevertheless, it was possible to obtain an excellent idea of the design, size, and attachments.

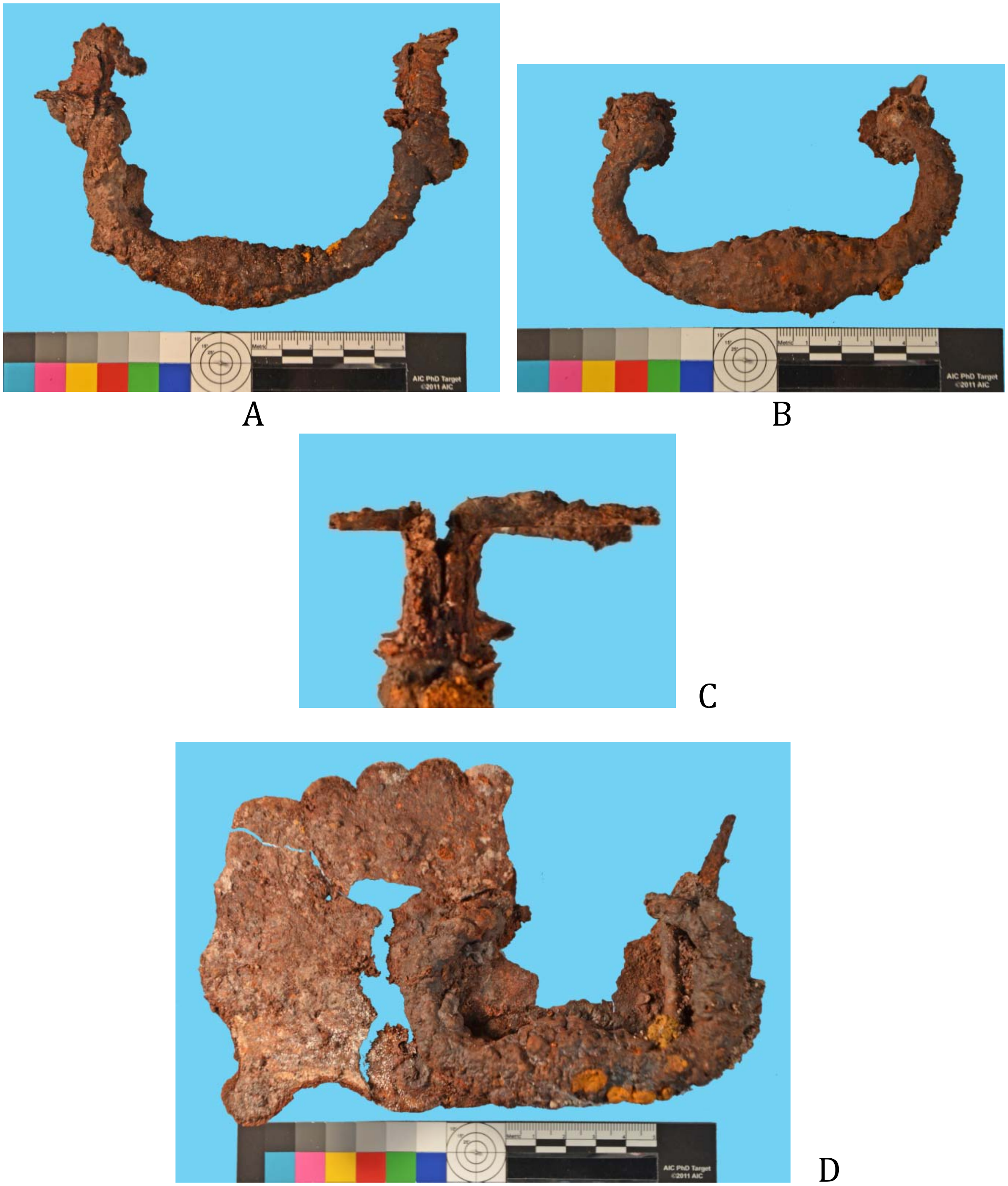


Figure 69. Handles from Vault 4. A, Large style handle. B, Small style handle. C, Clinching of handles to coffin sides. D, Remnant left side of a lug or backplate for the handles. Small style handle is seen on the plate.

There were three different styles of handles mixed together on the coffin. Two had straight handle sides. The drop measured 54 mm and the width of the handles was 107 mm. The handles were 8 mm in diameter with a slightly bulbous bottom.

The remaining four handles had incurvate sides and a pronounced bulbous bottom. Three of these four measured 114 mm in width with a drop of 49 mm. The handle diameters were 11 mm, with the bulbous base being 27 mm in diameter. The fourth handle had this same shape, but was smaller, having a drop of 45 mm and a width of 105 mm.

The two straight handles may have swung freely, based on their design and fittings. The remaining handles, however, clinched to the coffin sides.

Clinched fittings were illustrated by both Plume (1902:32) and Hasluck (1913:41), although by the early twentieth century tangs, into which the handles fit, were being clinched and all of the handles rotated. Nevertheless, Plumb remarks that even in the early twentieth century there was still a strong belief that handles "are for ornament and not for use" (Plume 1902:27).

Certainly the handles on this coffin were intended primarily for appearance. While the mix of sizes within a particular style may represent only variation in early manufacture, the different styles suggests that the local supplier did not have adequate stock. Moreover, it is clear that the "regulation" eight handles (three to a side and one each at the head and foot) were not installed.

While a number of backplate fragments were recovered, the only ones sufficiently intact to allow reconstruction were associated with incurvate handles. These plates measured 225 mm in width and about 110 mm in height. It is unclear if they were attached separately or held in place by the clinched handles.

One coffin wood fragment, probably from the base, clearly revealed an angled shoulder, indicating the use of hexagonal design, typical of the period. There was, however, a difference in design not seen in the other tombs. The coffin exhibited rounded corners, rather than the severe angled corners seen elsewhere. This style of coffin is briefly discussed by Plume (1902:120). This results in a more graceful shape, but was likely more difficult to construct. Thus, it was likely purchased rather than being made on the plantation.

Whether purchased or not, the wood was pine (*Pinus* sp.) as were the others identified at Orton.

The only other artifacts recovered from Vault 4 are two brass pins, usually identified as shroud pins. As previously discussed, Riorddan (2009) suggests these pins were actually used for attaching face or chin cloths.

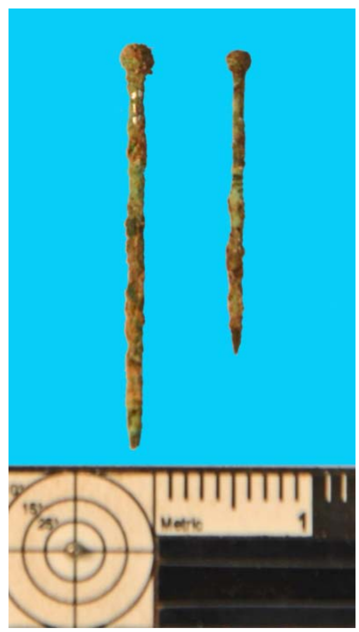


Figure 70. Shroud pins from Vault 4.

In Vault 4 these pins measured ¾ and 1-inch in length. Both were brass fashioned with wrapped heads and the longer one still revealed silvering.

Radiocarbon Dating

As with the other vaults at Orton, lacking name plates or even family tradition, it was impossible to determine when Vault 4 was constructed and used (although the artifacts are eighteenth century). In an effort to resolve that issue the fragments of coffin wood were submitted for AMS (accelerator mass spectrometry) dating using standard practices by Beta Analytic Radiocarbon Dating Laboratory (Beta-369543).

The analysis of this sample was ambiguous, being reported as 101.1 ± 0.3 pMC ("pMC" stands for "percent modern carbon"). Results are reported in the pMC format when the analyzed material has more ^{14}C than did the modern (AD 1950) reference standard. The source of this "extra" ^{14}C in the atmosphere is the testing of nuclear weapons that began in the 1950s. Its presence generally indicates the material analyzed was part of a system that was respiring carbon after the on-set of the testing (AD1950s). On occasion, the two sigma lower limit will extend into the time region before this "bombcarbon" onset (i.e. less than 100 pMC). In those cases, there is some probability for 18th, 19th, or 20th century antiquity.

Given these results, we decided to submit a rib from Individual A in this vault for AMS dating of bone collagen (Beta-372901). The results of this effort are shown in Table 15.

Table 15.
Radiocarbon Date of Burial A in Vault 4 (Beta-372901)

Conventional radiocarbon age:	130±30 BP
2 Sigma calibrated results: (95% probability)	Cal AD 1670 to 1780 and Cal AD 1800 to 1950
1 sigma calibrated results: 68% probability	Cal AD 1680 to 1715 and Cal AD 1720 to 1835 and Cal AD 1755 to 1760 and Cal AD 1800 to 1890 and Cal AD 1910 to 1935 and Cal Post AD1950

We believe it is reasonable to exclude dates prior to the establishment of Orton (ca. 1727-1730) and to exclude those dates after the sale of Orton out of the Moore family (1778).

Consequently, the 2-sigma date of AD 1800 to 1950 is discounted in favor of the AD 1670 to 1780 date, which spans the period of Moore ownership. If we are willing to accept a 1-sigma date, than the burial can be refined to AD 1755 to 1760.

This date correlates well with the death of Roger Moore in 1751.

Skeletal Remains

The skeletal materials in were laid along the south side of the vault, with the skull at the east end, and the rest of the remains anatomically laid out towards the east. There was little disturbance of the skeleton since interment, except for the smaller bones of the hands and feet, which may have been moved by animals or water intrusion. All remains were in excellent to poor condition, with some fragmentation, flaking and erosion, but little loss of individual bones. The cranium had a 2" x 1.5" gnawed hole on the left temporal bone, and nesting materials inside the skull vault. The condition of this interment was far superior to those in the other vaults.

The skeletal material was sorted as to bone type and side, and it was determined that these were the remains of one adult individual.

Individual A

One hundred thirty six bones were identified as Individual A, an adult. As stated above, the fragments were in good condition, and a number of measurements were obtained.

All post-cranial epiphyses had complete union, indicating an age of over thirty years (Buikstra and Ubelaker 1994:43). All ectocranial sutures were minimally closed, indicating an age of 25 to

Figure 71. Vault 4, Individual A, skull. Upper left, calvarium, left side. Upper right, skull and mandible, right side. Lower, skull, frontal view (not on Frankfort Horizontal Plane).

Figure 72. Vault 4, Individual A. Upper photo shows the mandible, super view. Lower photo shows the maxilla, inferior view.

65 years at death (Ubelaker 1989:84). The suture closures of the palate were significant to complete, indicating an age of 35 to 49 years (Buikstra and Ubelaker 1994:36). The pubic symphysis was scored at a Todd Phase 10, with a lipped superior edge, ventral erosion, and ossification of the face; this indicates an age of over 50 years (Buikstra and Ubelaker 1994:22); the Suchey-Brooks Phase is 5, indicating an age of 27 to 66 years (Brooks and Suchey 1990:233); the Suchey Revision is Phase E, for an age of over 45 years (Ubelaker 1989:80). The auricular surface of the ilium is ranked by Lovejoy as aged 50-60 years, with marked irregularity of the surface and margins (Ubelaker 1989:82).

X-rays were taken of the humeri, femora and clavicles; comparison with Askadi and Nemeskeri phases of structural changes ranked the humeri and femora as Phase IV, indicating age ranges of 50 to 61 and 49 to 63 years, respectively (Iscan 1989:180-181). The clavicles were compared with the Walker and Lovejoy series, and were ranked as Phase 7, with an age range of 50 to 54 years (Iscan 1989:184-185).

All permanent teeth had erupted and were fully formed, providing an age of over 35 years (Hillson 1996:145).

By examining all of these age related changes, the best estimate for age at death is 50 to 60 years.

While all 32 permanent teeth had erupted and formed fully antemortem, as shown by the intact bone, four were lost antemortem, probably due to decay or injury. The missing teeth included:

- $3M^1$ (maxillary right 1st molar), total resorption;
- $16M^3$ (maxillary left 3rd molar), root still in place;
- $23I_2$ (mandibular left 2nd incisor), total resorption, adjacent tooth movement;
- $31M_2$ (mandibular right 2nd molar), total resorption.

One tooth was in the process of being lost:

- $19M_1$ (mandibular left 1st molar), extant, but significantly worn, to below the gum line, with no enamel and total dentin exposure; root beginning to lose shape.

Only four caries were noted:

- $4P^2$ (maxillary right 2nd premolar), interproximal, was in contact with missing $3M^1$;
- $7I^2$ (maxillary right 2nd incisor), interproximal, in contact with $8I^1$;
- $8I^1$ (maxillary right 1st incisor), interproximal, in contact with $7I^2$;
- $18M_2$ (mandibular left 2nd molar), interproximal, in contact with $19M_1$.

An abscess along the maxillary left buccal area, above $16M^3$, was likely caused by the decay leading to the loss of that tooth.

It is interesting to note that all caries are interproximal, or touching other teeth, as opposed to occlusal or chewing surfaces, suggesting the development of caries due to food particles between the teeth.

There was moderate to significant wear on the occlusal surfaces of all teeth, with lines of dentin exposed on the incisors, signifying the effects of biting and chewing. The wear pattern on the molars suggests that this individual chewed with a rolling, grinding motion to the jaw. Only moderate amounts of calculus, or tartar, were seen on the teeth. The teeth were well formed and straight, including the three remaining mandibular incisors, which had shifted to the left, partially filling in the space of the missing $23I_2$. Because of the uniform wear on the incisors and lack of caries, it is probable that this tooth was lost as the result of an injury many years prior to death. There was probably pain associated with the abscess in the left mandible and the decayed $16M^3$ and $19M_1$. Overall, the teeth were good condition for an adult of this age in this time period.

The innominate, or pelvis, indicates that this individual was male. Overall, the vertical ilium, narrow pelvic inlet, narrow sciatic notch and flat sacral articulation are all morphological indicators of a male (Buikstra and Ubelaker 1994: 18).

The skull is large and robust, with blunt orbital borders, moderate supraorbital ridges, sloping frontal profile, moderately protruding occipital profile, nuchal crest, and blunt mastoid process; the chin is square with a marked gonial eversion. These morphological characteristics also indicate that this individual was male (Bass 1995:86).

Determination of ethnicity is based on the measurements and morphology of the facial portion of the skull. This skull has a pronounced nasal sill, high nasal bridge, narrow nasal opening, an orthognathous, or flat, face with retreating zygomatics, and rounded cranium, all anatomical features of an individual of Caucasian or European descent (Bass 1995:89).

Using the ForDisc 3.0 program, data from 24 cranial and 43 postcranial measurements calculated that this was a white male.

Measurements of the six long bones on each side indicated a maximum height of 5’5” to 5’10”, with an average of 5’7”. By using only the measurements of the right leg bones, the maximum height is 5’8” to 5’10” (Bass 1995:29). The ForDisc program calculated a maximum stature of 5’6” to 5’9” (90% prediction interval using nineteenth century white male statistics).

The sacrum segments were fused, but the median crest, or neural arch, was incomplete on all five sections, creating open spaces across the posterior of the bone ranging from 12.0 to 20.3 mm. Normally the neural arches fuse between the ages of two and seven years. In addition, the 5th lumbar vertebra had never fused. These are all classic indicators of serious spinal bifida occulta, previously discussed. The extent of this SPO is seen in about 7% of the modern population, although it is one of the most frequently documented developmental defects to be reported archaeologically (Roberts and Manchester 2003:55). Given the extent of the SPO suffered by


Figure 73. Vault 4, Individual A. Left innominate, interior view.

this individual, it is likely that he suffered moderate to intense back or leg pain during his life (Talley Parrott, M.D., personal communication, 2014).

The sacrum was also skewed in shape, with the left spinal articular surface tilted down and the right spinal articular surface tilted up. The left articular surface is larger than the right, being 14.9 by 11.8 mm and 9.1 by 11.1 mm respectively. The right articular surface is twisted almost flat in position with the ala.

The innominate articular surfaces are also distinctive: the right is flat and mildly lipped with an irregular surface; the left is normally shaped and moderately lipped with a dense surface. The promontory is moderately lipped, especially to the posterior, with a heavily osteophytic body and two Schmorl's nodes.

The Schmorl's nodes indicate two instances of herniated disc; as the disk herniated, it actually protruded into the vertebral surface, causing the bone defect. While this is common in individuals over the age of 45, as the result of degenerative disk disease (Aufderheide and Rodriguez-Martin 1998:97), it is also common in cases of SBO (Mann and Hunt 1990:95). The herniation likely causes pain in the back or legs.

As noted above, the 5th lumbar vertebra was unfused, functioning as three separate pieces antemortem: the spinous processes had never joined with each other or the vertebral body to create the neural arch. These normally fuse at the age of two to four years (Baker et.al. 2005:81). The left and right portions of neural arch were extant, with osteophytic growth on the proximal ends, matching the osteophytic growth on the body of the vertebra, indicating contact of the arch portions with the body, but no actual fusing or permanent attachment. The left spinous process portion was larger and more rugged than the right portion, which is long, narrow, and lies almost flat against the body of the sacrum.

Each of the lumbar vertebrae had Schmorl's nodes, indicating multiple episodes of disk herniation in the lumbar area (Mann and Hunt 1990: 95). In the case of individuals with SPO, the lumbar Schmorl's nodes may also be a component of the syndrome, and developed prenatally (Parrott, personal communication, 2014). Additionally, each of the lumbar vertebrae had raised rims, pitting and osteophytes on inferior and superior bodies. This is evidence of moderate osteophytosis, or the degeneration of intervertebral disks, a symptom of osteoarthritis. As the intervertebral disks degenerate, the vertebral bone on either side begin touching; as a reaction to the bone contact, the body creates a protective barrier of bone, or osteophytes, on the inferior and superior aspects of the vertebrae. The porosity and pitting of the vertebral bodies is also seen as a result of osteoarthritis (Aufderheide and

Figure 74. Vault 4, Individual A. Sacrum, posterior view.

Rodriguez-Martin 1998:97).

All twelve thoracic vertebrae were present. All were pitted and osteophytic, indicating osteoarthritis (Aufderheide and Rodriguez-Martin 1998:97). Thoracic vertebrae 5, 7, and 12 each had a Schmorl's node, indicating multiple episodes of disk herniation in the thoracic area (Mann and Hunt 1990:95).

All seven cervical vertebrae were present. All except the atlas were pitted and osteophytic, indicating osteoarthritis (Aufderheide and Rodriguez-Martin 1998:97). Cervical vertebrae 3, 4, and 5 were compressed at the inferior surfaces, indicating a slight to moderate hunch to the upper back.

Both right and left femora, tibias, and fibulas were recovered. The femora had some flaking, erosion and crumbling, but were in good, stable condition. On both, the intertrochantic line was raised and rugged. This area anchors the iliofemoral ligament, the largest ligament in the body, and strengthens the joint capsule of the hip and provides support during hip extension (White 2000:233). Both also had a rugged lateral epicondyle, which is the attachment area for the lateral collateral ligament of the knee, as well as the gastrocnemius muscle, a flexor of the knee and ankle, which strengthens the knee and is important in initiating a step in walking (White 2000: 236). Both also had a deep, pitted popliteal groove, where the tendon of the poplitus muscle attaches; this muscle is used in the dorsal flexion of the legs and feet, a component of walking (White 2000: 236). The patellar surface of both femora had a lipped and pitted superior edge; this is the area upon which the patella glides during flexion of the knee, another walking component (White 2000: 239).


Figure 75. Vault 4, Individual A. Fifth lumbar vertebra, superior view.

Figure 76. Vault 4, Individual A. From the top down, left femur, anterior view; right femur, anterior view; left tibia, anterior view; and right tibia, anterior view.

The right and left patellae are in good condition; both are pitted, osteophytic and lipped on the posterior surface, which articulates with the femur (White 2000: 241). The condition of the proximal area corresponds with the lipped and pitted patellar surface of the femur, and indicates the moderate erosion of the cartilage that normally sits between the articular surfaces. Degeneration of the knee due to osteoarthritis is the earliest involved of all the joints, and can begin in the fourth decade of life (Ortner and Putschar 1985:419). The apex of each patella was also lipped, where the patellar tendon attaches; this tendon aids in the straightening of the leg (White 2000:241).

Figure 77. Vault 4, Individual A. Lateral view of the right calcaneus.

The tibias were cracked and flaking, but otherwise in good condition. Each presented mildly pitted proximal condyles, the area of knee articulation (White 2000:245). Each of the malleolar grooves, which anchor the tibialis posterior and flexor digitorum longus muscles, had rugged edges, indicating more than moderate use. The tibialis posterior muscle serves to stabilize the leg, provide plantar flexion of the foot and ankle, and provide arch support. The flexor digitorum longus muscle is used for curling the second through fifth phalanges, or toes (White 2000:245). Each medial malleolus was short and rugged; this area is the articular surface for the talar body, creating the medial portion of the ankle joint (White 2000:245). The inferior fibular articular surface, the contact surface between the tibia and fibula, is lipped. The distal articular surface, or fibular notch, is lipped, pitted, and osteophytic; in combination with the fibula, this area is the proximal ankle joint, and articulates with the talus (White 2000:245).

The fibulas were in similar condition as the femur and tibia. While this bone is not a load bearing bone, it is important in the formation and use of the lateral portion of the ankle. The proximal fibular articular surfaces of each was only slightly pitted, but moderately lipped; this area is in direct contact with the lateral proximal tibia (White 2000:249). The malleolar fossae are deep and lipped; this area is where the transverse tibiofibular and posterior talofibular ligaments attach, strengthening the ankle joint (White 2000: 249). The malleolar distal articular surfaces are flat, vertical and lipped; this area articulates with the talus, forming the lateral portion of the ankle (White 2000:249).

Of the 12 tarsal bones forming the posterior area of the feet, only one, the right first cuneiform, was missing. All evidence some erosion, but are otherwise in good condition. The right foot bones are larger, more robust, and more lipped than those of the left side. There are large spurs on the posterior of each talus, the contact area with the calcaneus. The right talus has a boney ridge on the distal portion of the lateral malleolar surface, which articulates with the small groove and osteophytic growth on the distal portion of the right fibula distal articular surface. The talus may be the site of such

Figure 78. Vault 4, Individual A. Top is the anterior view of the left humerus. Bottom is the anterior view of the right humerus.

extensive changes because it bears the weight of the body during standing and walking (Matches et.al 2005:394).

The right calcaneus has an enthesophyte, or heel spur; this is likely the result of repeated trauma, or repetitive stress, of the Achilles tendon or plantar tendon. In current populations, 16% of individuals over the age of fifty years have this bone spur on one foot (Mann and Hunt 1990: 206). The development of this spur is consistent with walking long distances while favoring the right leg. The spur itself is not painful, but is the result of the inflamed tendon irritating the calcaneus. The inflamed tendon, running along the heel and the arch of the foot, is typically painful only when walking after a period of resting.

Only 17 of the 20 metatarsals were recovered. The tarsals have osteophytic growth on the proximal plantar surfaces, more aggressively on the right than the left, but are otherwise not remarkable. No phalanges of the foot were recovered.

The muscles of the leg allow the human body to walk and run. The femora, tibias, fibulas and patellae all exhibit particular ruggedness, pitting and lipping that indicate that this individual walked a good deal. In all instances, the right side was slightly more affected than the left, suggesting the favoring, or heavier use, of the right leg. The repeated stress of walking appears to have caused a calcaneal bone spur on the right foot.

The humeri were both present, but were more eroded than the lower extremity bones, and had white powdery accretions, likely eroded mortar from the vault. While the left humerus was unremarkable, the right humerus had a deep radial fossa and a slightly lipped medial epicondyle. The deltoid tuberosity was mildly rugged; this is the site of insertion of the deltoidus, or shoulder, muscle, which raises and rotates the arm (White 2000:184). This rugosity may represent the use of the right arm in repeated use of a staff during walking (Capasso et. al. 1999: 67).

The radii were both present, with minor

flaking, erosion, and with white powdery accretions. The left radius was unremarkable except for some osteophytes and pitting of the lower articular surface and the ulnar notch, as well as a lipped, pitted styloid process. The right radius had a styloid process that was lipped, with a distorted, concave shape and a pitted, osteophytic ulnar notch; these areas create the proximal portion of the wrist. The radial tuberosity was round and rugged; this is the attachment point for the biceps brachii muscle, which flexes the forearm (White 2000:188). The dorsal tubercle was pronounced; this is the area that holds the tendons for the extrinsic extensor muscles of the hand, which serve to flex, or extend, the wrist and individual fingers (White 2000:191).

The ulnae were both present, with minor flaking, erosion, and with white powdery accretions. Both sides evidenced a short, narrow, lipped styloid process; this is the attachment area of the ulnar collateral ligament of the wrist, which stabilizes the movement of the wrist (White 2000:193). Both also had a rugged, lipped ulnar tuberosity, where the brachialis muscle attaches, and allows the flexing of the elbow.

Both ulnae had a lipped and pitted olecronon process, where the triceps brachii muscle is attached; this muscle is the primary extensor of the forearm (White 2000:192). Each ulnae also had a deep, lipped, osteoporotic radial notch and coronoid process, areas where the elbow joint itself is formed. These changes suggest the moderate to heavy use of the elbows and wrists. All of these changes were more remarkable on the right bone than the left.

The measurements of the humeri, ulnae and radii also showed that the right bones were consistently larger than the left bones. The metric and non-metric characteristics suggest that this individual was right handed.

Each hand consists of eight carpal bones. Only five carpal bones for each hand were recovered for this individual. All evidenced moderate to severe erosion due to burial conditions, as well as moderate lipping of the articular surfaces, indicating moderate to heavy use of the wrists (Aufderheide and Rodriguez-Martin 1998: 93).

All metacarpals were recovered, except for the first, or thumb, metacarpals. The metacarpals of the left hand were unremarkable, while those of the right hand were lipped on all proximal and medial articular areas.

Each hand consists of fourteen phalanges. Seven phalanges were recovered from the left hand, and were unremarkable. Eight phalanges were recovered from the right hand, with lipping only on the proximal articular surfaces of the proximal second and third rays, or first and second fingers, and heavy osteophytes on the distal phalanges of the second, third and fourth rays, or first, second, and third finger. The phalanges for the right hand were slightly more robust and longer than those of the left hand.

As mentioned above, the missing smaller bones were probably lost to small animal activity. Wrists and fingers indicate moderate to heavy use of the wrists and hands, while the generally larger size of the right hand bones again suggest that this individual was right handed.

The right scapula was, as with other bones, larger than the left scapula, but neither showed evidence of osteoarthritis. However, the surfaces of the acromion processes were rugged; this is the attachment point for the deltoidus and trapezius muscles. As noted above, the deltoidus muscle is also attached to the humerus, and raises and rotates the arm. The trapezius stabilizes and moves the scapula itself (White 2000:184). The robustness of the scapulae suggests muscular shoulders.

The clavicles were in poor condition, with crumbling, flaking and cracking of the surfaces. While the left clavicle was unremarkable, the right clavicle had a wide subclavean sulcus, the insertion point for the subclaveous muscle, which stabilizes the clavicle during shoulder movement; a rugged superior surface, the attachment point for the trapezius muscle, which was also

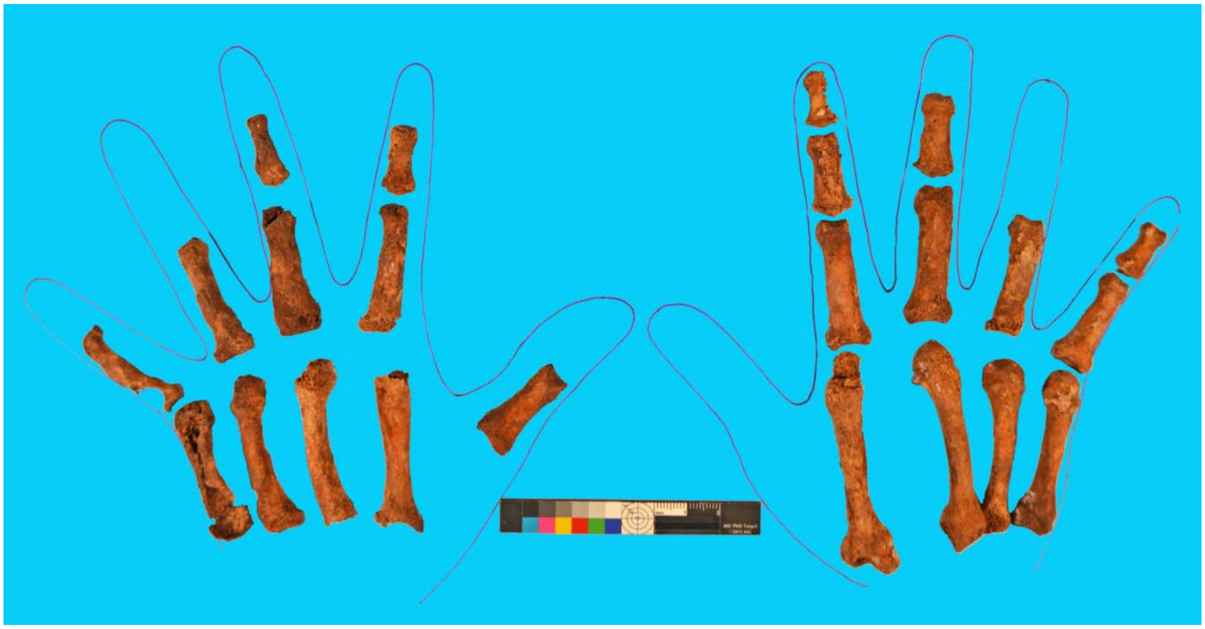


Figure 79. Vault 4, Individual A. Carpals and phalanges of the left and right hands, superior view.

pronounced on the right scapula; and a rugged, osteoporotic costal tuberosity, the anchor of the costoclavicular ligament, which strengthens the sterno-clavicular joint (White 2000:169). These characteristics also support the theory of the use of a walking staff by the right hand and arm.

The unfused body and right greater horn of the hyoid were recovered in good condition; although the hyoid bone has not been extensively researched by bioanthropologists, it is not uncommon to find it unfused in individuals under the age of 60 (Iscan 1989:122).

The sternum was recovered in good condition as two unfused portions, the manubrium and the corpus sterni; the xiphoid process was not recovered. The clavicular notches and all costal notches were pitted and lipped, indicating osteoarthritic changes; more importantly, the sternum was slightly tilted to the left, indicating a slight curvature of the ribcage, possible related to the mild curvature of the individual's spine, or advanced age (Iscan 1989: 130).

All of the ribs were recovered in fair condition; all sternal ends were broken off post-mortem, and there was crumbling of the costal ends as well as the inferior and superior edges. All heads and tubercles, which articulate with the thoracic vertebrae, were moderately to heavily lipped. The third through ninth ribs, both sides, had a flowing, wavy osteophytic growth on the inferior body. These may be evidence of a chronic lung disease, such as emphysema, bronchitis or pleurisy, which caused pulmonary inflammation, eventually resulting in rib distortion (Aufderheide and Rodriguez-Martin 1998: 264). It is also possible that these distortions were caused by tuberculosis (Anson et.al. 2012: 62), although no other skeletal indicators of this disease were present.

The DNA analysis indicated that this individual was male of European descent, with a maternal link to Individual A, Vault 1 (adult female) and Individuals A, X, Y1, and Z1, Vault 2 (adolescent male, 3 infants). Without further information, the current assumption is that these individuals are his adult sister, adolescent nephew, and infant nieces and nephews.

In order to more definitively identify this individual, a living male direct descendant of Roger Moore was located and he kindly contributed a buccal swab for comparison. Comparison of the Y-chromosomal profile of both individuals indicated the descendant and the skeletal remains shared a common paternal ancestor. The frequency of this particular Y-chomosomal profile among the general population is 0.000038 (Fratpietro 2014e).

In summary, this adult male of European descent stood between 5’4” and 5’10”, and was likely 50 to 60 years old upon death. He was born with the condition spina bifida occulta, which may have caused moderate to severe leg or back pain. He had a slight to moderate hunch of the upper back and suffered from several herniated disks, which may have contributed to his back pain. Morphological analysis indicates that he was right handed, walked enough distances in his lifetime to cause rugged musculature, arthritis, and a bone spur in his lower extremities, and likely walked with a walking staff. Although he lost a lower incisor in his childhood or early adolescence, the surrounding teeth moved in to close the space, resulting in a straight, ungapped smile. Four molars had been lost to wear and decay many years before his death, but he had only four small caries, or cavities, in his remaining teeth. As an adult, he appears to have suffered from an unspecified lung condition, in which coughing or difficulty breathing caused bony changes in his ribs.

Parasite and Pollen Study

As previously mentioned, only the remains in Vault 4 were sufficiently well preserved to allow the collection of a soil sample from the abdominal region for examination of possible parasites.

The examination yielded no parasite eggs, suggesting that this individual did not harbor intestinal parasites (specifically *Ascaris*, a roundworm, or *Trichuris*, whipworm). The sample was next scanned for pollen, which was not particularly abundant, to establish the likelihood that the sample represents the intestinal area.

Pollen observed included Cerealia, representing cultivated cereals that would have been consumed, such as *Triticum* (wheat), *Avena sativa* (oats), *Hordeum vulgare* (barley), *Secale cereale* (rye), *Oryza sativa* (rice), and *Zea mays* (maize).

Their presence would indicate that the sample probably reflects gut contents. Other pollen noted that represent local vegetation include *Pinus*, *Quercus*, Highspine Asteraceae, Cheno-am, *Parthenocissus*, and Persicaria-type indicating presence of pine and oak trees, various members of the sunflower family, goosefoot and similar weedy plants, Virginia creeper, and knotweed that prefers moist or wet conditions.

Total pollen concentration was more than 4000 pollen per cubic centimeter of sediment, but was severely diluted by the presence of partially digested organic matter, likely meat, which was noted as amorphous organic material that could not be removed during acid treatment of the sample.

This analysis was informative. Parasites were particularly prevalent in urban centers from at least the seventeenth century on (Fisher et al. 2007:189). They often affected individuals in relatively minor ways and Fisher and his colleagues noted that roundworm infection is more of a nuisance than a major health threat, and adults may not experience any symptoms of a whipworm infection. The absence of parasites suggests that the individual in this vault practiced good hygiene and minimized exposure.

The pollen study also confirms the presence of cereal grains at Orton. In addition, we see that a variety of other local plants were also present, such as goosefoot, smartweed, sunflower, and Virginia creeper.

Perhaps of greatest interest is that the individual in Vault 4 apparently had a full meal shortly before his death, based on the quantity of meat and plant material present in the gut.

Vault Architecture

There is remarkably little information on the design and construction of colonial burial vaults or tombs. Relatively few individuals were sufficiently wealthy to allow such structures and it seems that very few have been investigated.

Orton

Table 16 provides an overview of the four vaults at Orton. The lengths (measured east-west) of these vaults average 8’9”; the widths (measured north-south) average 6’2½”; and the interior heights average 4’11”. Only Vault 1 deviates appreciably.

Roof construction includes both brick gables and brick arches. It is perhaps telling that Vault 4, which exhibits a gable roof, on the interior has a brick arch. This vault has never collapsed or suffered from extensive rebuilding and it reveals that the original construction relied on an arch to support the bricks laid to form a gable. Of course, no evidence of this construction remains at Vault 1, which has been completely rebuilt. Vault 3, however, seems to have the remnant row of bricks over the arch that might originally have been a gable.

Table 16.
Summary of Orton Vaults

Vault	E-W	N-S	Interior Height	Roof Construction
1	10'0"	7'0"	6'11"	gable
2	7'9½"	4'2½"	4'7¼"	arch
3	7'10"	6'7"	3'11½"	gable
4	9'4"	7'1"	4'3"	arch
mean	8'9"	6'2½"	4'11"	

All of the vaults appear to have been constructed by first excavating a hole or “basement,” then laying up the brick from the interior. All of the vaults incorporated crudely laid brick floors and brick knee walls to hold the coffins off the floors. There is evidence that the masons used form work on the interior, removed before burials were interred, to support the brick arch construction. The interior of the vaults did not originally receive stucco or any other finish. Exterior brick was not especially laid since all of the tombs received exterior stucco scored to resemble ashlar. While not conclusively demonstrated at Orton, such stucco was frequently white washed.

Each tomb had either an arched or, in the case of Vault 1, a square opening through which coffins were placed in the vault. Again with the exception of Vault 1, these were generally small and would have required servants inside the vault to receive the coffin and position it. It is reasonable to expect these openings to have been periodically used for the placement of additional coffins, although subsequent repair episodes have largely masked such events.

North Carolina

We have found no reports of colonial vault excavations in North Carolina, although Charles Ewen reports on two dating from the early nineteenth century found in Kinston, North Carolina. Both consisted of below grade arched brick burial vaults, each holding a single iron coffin. The larger of the two vaults measured about 7.8 feet in length and 3.6 feet in width (Ewen 2014; Jorgenson et al. 2001). These are analogous to vaults still used today as protective enclosures for individual caskets and are not directly comparable to the family vaults found at Orton.

Figure 80. Orton vaults. Upper left is Vault 1 looking northwest. Upper right is Vault 2 looking northwest. Lower left is Vault 3 looking northeast. Lower right is Vault 4 looking northwest.

Seeman (2011) reports on the excavation of a largely destroyed nineteenth century brick vault on the Foscue Plantation in Jones County, North Carolina. The underground portion measured 8.8 feet east-west by 14 feet north-south and was plastered. She interprets the vault to have had a door on its northern wall, based on artifacts. She speculates that the vault had a gabled wood roof, similar to other coastal vaults, especially those from the New Bern Cedar Grove Cemetery (Seeman 2011:95-96).

Landmark Preservation Associates (2010:1-8) mentions that Governor Nathaniel Rice (d. 1753) is buried in a brick barrel vault in the Winnabow area. At least one oral history from Helen Taylor, whose grandparents bought Winnabow Plantation, remembers that the tomb was tall enough to walk into. We have not been able to visit or otherwise confirm this information.

Ruth Little (1998) provides some general discussion of North Carolina vaults without respect to their precise date. In fact, she notes that "only a few vaults have inscriptions, thus most are impossible to date with precision" (Little 1998:9). She echoes our observation that they were constructed only by the wealthy, citing one antebellum account of a stone and brickwork vault costing nearly $300 in contrast to the typical $10 paid for a tabletstone.

Based on her extensive observations, she notes that most are found in coastal areas, although a few occur as far inland as Cumberland County, about 85 miles inland. She suggests they occur because of the high water tables, but also identifies them as the "last vestige of several types of medieval British monuments" and recognized that "burial in tombs was a tradition wealthy colonists no doubt brought from Great Britain"

Figure 81. Examples of two gabled family tombs at Cedar Grove Cemetery in New Bern, North Carolina.

(Little 1998:10). Thus, their occurrence may have more to do with early coastal settlement by the English than with the water table. Nevertheless, she also notes that both arched and gabled styles exist.

Harold Mytum (personal communication 2015) specifically notes that vaults similar to those at Orton are not present in England, although below ground brick vaults, often with coffin shelves, stair entrances, and barrel roofs, are found. These seem very similar to those found at Colonial Cemetery in Savannah, Georgia (discussed below). Litten (1996) does note that a single occupant brick-lined shaft grave with a vaulted roof was popular with the merchant classes in England at the end of the eighteenth century.

Of far greater interest are vaults in Ireland that appear far more similar to those at Orton (Harold Mytum, personal communication 2015). This is of special interest given that the Moore family spent time in Ireland and may have retained strong cultural connections.

Speaking of the Old Burying Ground at Beaufort, North Carolina, dating from 1731, Little notes that most of the early graves,

> are "bricked" with low vaults projecting from the ground, some domed, some gabled. Most have stepped ends . . . Variations on this design include submerged brick vaults with only the top of the vaults visible (Little 1998:47).

Seeman suggests a somewhat different evolution of vault forms. In the first several decades of the nineteenth century she believes "rectangular, flat-roofed brick vaults were common." By mid-century "more elaborate mortuary displays" became common, such as the Rhem family stuccoed brick vault and "barrel-shaped brick barrel vaults."

None of these discussions, however, provide much information on eighteenth century mortuary traditions or vaults.

South Carolina

We are familiar with only one vault excavation in South Carolina, conducted by Ted Rathbun at the Hutson Crypt (also the Hutson-Peronneau vault) in the Independent Congregational (Circular) Churchyard in Charleston. This is the largest monument in the cemetery, measuring about 10 feet square and about 10 feet in height. It is thought that Arthur Peronneau, who died in 1774, was the first person buried in the vault, which contained at least 18 individuals.

This vault, however, is unlike those discussed by Little from North Carolina, having a

Figure 82. Burial vault forms in North Carolina. The upper two photos show a gabled and arched vault for a single burial at the Old Burying Ground in Beaufort, North Carolina. Intended for a single individual, these are reminiscent of grave houses. The middle left photo shows the interior of such a vault, with wood framing that originally supported the arched ceiling, as well as the single casket. The middle right photo shows a flat roofed family vault at the Old Burying Ground. The lower left photo shows the more elaborate Rhem family vault at the Old Burying Ground. The lower right photo shows an arched and pedimented J.H. Pool family vault, also at the Old Burying Ground.

Figure 83. South Carolina vaults. The upper photo shows a square brick vault at Trinity Cathedral, Columbia, South Carolina. The lower photo shows an arched vault in Mount Pleasant, South Carolina.

flat roof and essentially looking like a brick box. It is, however, very similar to a vault found in Trinity Episcopal Churchyard in Columbia, South Carolina.

An arched vault was identified in the Mount Pleasant, South Carolina area. While broken open and robbed, it never received archaeological attention.

Georgia

We conducted fairly extensive research on four brick vaults in Savannah's Colonial Park Cemetery (Trinkley and Hacker 1999). The cemetery was opened in 1753 and used until about 1853. One of the tombs (C-65) was that of the Foley Family, used perhaps as early as 1836. The remaining three (J-4, I-83, and I-86) lacked any markings. The primary goal was to document construction techniques to aid eventual restoration, but two of the vaults were opened and this provided an opportunity to also document aspects of internal construction and use.

One of the most visible, and certainly characteristic, aspect of the cemetery is its brick tombs or family vaults. These tombs have either gabled or barrel roofs, parapet walls on the east and west elevations, and were constructed at least partially below grade. While thought to have originated in the colonial period, they continued to be constructed into the antebellum at Savannah's Laurel Grove Cemetery and at the Catholic Cemetery.

The dimensions of these tombs are shown in Table 17. While the dimensions are variable, widths are always greater than lengths, and the average width was 11'8½"; the average length was 9'7". Only I-83 was entered by way of an arched opening bricked after each use – similar to the vaults at Orton. The other tombs all had steep, narrow stairs originating outside the vault and covered with a stone slab. Placing a coffin in the tomb using these stairs must have been a challenge. With one individual in the tomb and another outside, the coffin would have been slid down the stairs, rather than being carried. In this sense the stairs are far more symbolic than functional.

Two distinctly different tomb openings were documented. One is an above grade arched opening which required removal and replacement as the tomb was used. The second was an at-grade stair entrance usually covered with a large slate slab.

The two tomb interiors available for

Figure 84. Family vaults in Colonial Park Cemetery, Savannah, Georgia. Upper left is the west elevation of C-65. Upper right shows remains on the floor of C-65. Middle left shows the stairs leading into C-65. Middle right shows the west elevation of I-83. Lower left shows the interior of I-83 and supports for coffins. Lower right shows I-86 which lacked stairs and was entered through the arch shown in the lower middle of the photo.

Table 17.
Dimensions of Family Vaults Examined at Colonial Park Cemetery

Vault	E-W	N-S	Internal Height	Opening
C-65	11’	9’11”	9’	2.3x2.9’
J-4	11’1’	9’1’	9’	3.2x2.5’
I-83	13’8”	10’9½”		2.6x3.0’
I-86	11’1½”	8’6”		2.4x3.1’

inspection were very different from one another. In one case (C-65) the vault was opened and coffins were presumably stacked on top of one another. In the case of I-83, the tomb was designed with a vestibule at the case of the stairs about 5-feet in depth. There was a center wall running from the vestibule to the back wall of the tomb, about 8.7 feet in length. This wall provided support for two tiers or shelves of slate. The shelves were supported by brick tabs in the side walls and supported the coffins.

A simpler vault design is found in Athens, Georgia, at that city’s public cemetery, dating from at least the first quarter of the nineteenth century. This vault has an arched opening at the west elevation. During repairs it was found filled with soil, so its original internal construction could not be determined.

Another version is found in the Sandersville Old City Cemetery in Washington County, Georgia. This vault is arched, with pediments at the east and west ends. A nearly identical brick tomb for Mary Helena Lynes (1861-1892) is found in Atlanta’s Oakland Cemetery, suggesting this style continued well into the nineteenth century.

The Athens and Sandersville vaults, while far less elaborate than those at Colonial Cemetery in Savannah, are situated nearly 200 and 120 miles inland from Savannah respectively. The Oakland vault is over 200 miles from Savannah. Thus, while these tombs may have originated among the earliest coastal settlers, at least a few families brought the tradition inland as settlements migrated. In addition, the Oakland vault reveals that the form continued to be used until the end of the nineteenth century.

Virginia

The partially collapsed West Family Vault (44AX183) in Alexandria, Virginia was excavated in 2002 (Polglase et al. 2004). The West’s were one of Alexandria’s leading wealthy

Figure 85. Brick vaults in Georgia. The upper photo shows a vault at the Old Athens Cemetery in Athens, Georgia. The lower photo shows a vault in the Sandersville Old City Cemetery in Sandersville, Georgia.

Figure 86. Brick burial vaults beneath the floor of the Chapel in the Wren Building, College of William and Mary, Williamsburg, Virginia.

families in the mid to late eighteenth century. The brick vault was found to measure 10 by 8 feet and although truncated, debris suggests it was arched. The floor, rather than being bricked, was wood, supported by two brick runners in the tomb.

Seven individuals were recovered from the vault. In spite of the West's wealth, all of the individuals were buried in pine coffins and only a few brass tacks were used. The absence of clothing remains indicates the use of shrouds. Coffin handles, while scarce, were all bail handles similar to those found at Orton. Beyond the vault were a series of later individual burials.

The authors observe that vault burial was seemingly not the norm and when they occurred were constructed by families of wealth (Polglase et al. 2004:115). They note that Smithsonian anthropologist Lawrence Angell observed that, "family vaults of the colonial period were relatively low structures" with "bodies and/or coffins frequently . . . stacked directly atop one another (Polglase et al. 2004:115).

Also briefly mentioned is the Thompson family vault at Darnell's Chance, which measures 8 by 17 feet by 8 feet in height.

Dr. Joseph Jones at the College of William and Mary relates the vaulted structures at Orton to somewhat similar structures in a "crypt" space beneath the floor of the Chapel wing of the Wren Building at College of William & Mary. Ms. Susan Kern, Director of the Historic Campus, points out that while similar in construction (albeit much less finished), they were always under the chapel floor and never had a roof allowing them to be outdoors (Joseph Jones, personal communication 2014). Among those buried in these vaults are Sir John Randolph, his sons John "the Tory" and Peyton, Bishop James Madison, and Lord Botetourt, the colonial governor.

Elsewhere

Another vault was excavated in New York, although unfortunately only a letter report was prepared and no bioanthropological studies were conducted. The vault is described as measuring 6 by 8 feet by 8 feet in height with a "barrel-vaulted ceiling." Access was by way of stairs in one corner, suggesting an at-grade entrance. It contained eight individuals, apparently laid out in hexagonal coffins supported by two brick knee walls. It is reported that this vault dated from the 1850s (Loorya 2008).

There seem to be no comparable examples in the Boston area (Barbara Donohue, personal communication 2014).

Williams and his colleagues (2001) note the presence of single occupant vaulted burial structures at a several Halifax churches, including the Little Dutch Church, Saint Paul's, and St. George's. All seem to be associated with the German community.

Turning to the south, there are several similar brick and stucco examples documented at the St. John's Parish Church in the Barbados where the earliest documented grave dates to 1678.

Summary

While single burial vaults are common throughout the nineteenth century and continue into the twentieth century, they have little in common with the Orton tombs from the middle of the eighteenth century.

Looking at the array of family vaults one is immediately impressed with the architectural variation. There are vaults primarily above or below grade; vaults with gable or arched roofs; vaults that are all brick or combination of brick and wood (much like a domestic structure); vaults with sealed entrances or readily accessible entrances; entrances at grade and entrances via steps below grade; and vaults with shelves for storage of remains, vaults where remains were stacked, and vaults where remains were laid on brick supports.

Some of these variations are doubtless the result of differing masonry skills. Other variations are likely local. It seems certain that much of the confusion is the result of a very small sample and an almost near absence of dated vaults with detailed archaeological investigations. In addition, it seems that many vaults are found in ruinous condition and little can be ascertained from the remaining rubble.

Consequently, the work at Orton Plantation assumes particular importance since construction techniques and architectural details have not only been carefully documented, but the vaults can all be dated to within a generation. In fact, they represent the only sample of colonial vaults explored in North Carolina.

Isotopic Evidence for Diet

We have previously provided some brief background concerning this research in the Methods section. We noted that bone samples from adults in Vaults 1, 2, 3, and 4 were submitted for stable isotope analysis using the carbon isotopes ^{12}C and ^{13}C and the nitrogen isotopes ^{14}N and ^{15}N. Figure 10 compares stable carbon versus nitrogen ratios for plant and animal groups provided by three researchers, demonstrating how results, while similar, can vary by location.

Background

Archaeologists most commonly use the collection and analysis of faunal and floral remains as the mainstay in dietary reconstructions, although processing tools and remains can also provide significant evidence (see, for example, Wing and Brown 1979). Archaeologists, however, do not always include foodways in their research. For example, there is barely a mention of food remains in South's *Archaeology at Colonial Brunswick* (South 2010). Of course, at Orton we do not have access to any of the site areas where food remains might be present.

Archival documentation can provide significant information – where it exists. For example, Thomas Jefferson left detailed farm records, providing significant clues concerning foodways at Monticello (Baron 1987). No such records, however, have been found for Orton.

Under such circumstances archaeologists are increasingly turning to chemical studies (e.g., Ubelaker and Owsley 2003, France et al. 2014). The most common is the analysis of isotopes of carbon and nitrogen since the work can often demonstrate if the diet was based on plants with a C_4 pathway and/or the herbivores that consume those plants. Examples of plants with a C_3 pathway include shrubs, trees, and most leafy plants growing in temperate climates. In contrast, C_4 plants include grasses such as maize, millet, sugarcane, and rice, typical of more hot and dry climates. Consumption of marine foods produces results between those from C_3 and C_4 sources.

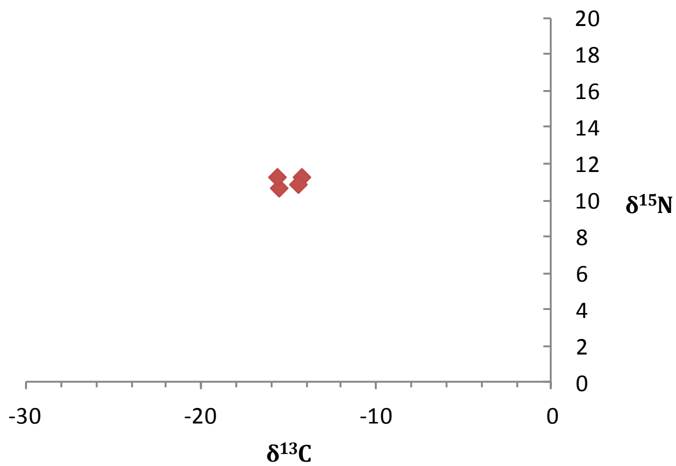
In general, previous studies reveal that bone from humans consuming primarily C_3 plants produce δ^{13} values of about -20‰. Less negative numbers suggest consumption of C_4 plants, animals that consumed C_4 plants, and/or a diet rich in marine foods. Bone from those relying on C_4 plants can produce carbon isotope values as high as -6‰.

This data can be maximized by also examining nitrogen isotopes. Leguminous plants (such as beans, peas, and peanuts) have the lowest values, with values increasing as one moves up the food chain. Humans with a reliance on maize have $\delta^{15}N$ values of about 9.6‰. In contrast, a reliance on seafood will result in values of about 15‰.

Recently France and her colleagues (2014) have expanded this research, looking at stable carbon, nitrogen, and oxygen isotopes from the bones of eighteenth and nineteenth century individuals of known ancestry, social class, and region of origin. Differences appear linked to both food preferences and availability. In addition, they found that urban settings produced greater variability, perhaps reflecting a variety of regional or cultural backgrounds. For example, they found that the means for the upper class were 11.1‰ $\delta^{15}N$ and -15.5‰ $\delta^{13}C$ compared to 10.3 and -12.1 for enslaved African Americans.

Results

The results for the four adults are shown below in Figure 87. They form two very tight clusters, with the results from Vaults 1 and 4 and



Individual	13C/12C	15N/14N
Vault 1, Individual A, R femur	-14.3	11.3
Vault 2, Individual A, L femur	-15.6	10.7
Vault 3, Individual A, R femur	-15.7	11.3
Vault 4, Individual A, rib	-14.5	10.9
mean	-15.0	11.1
standard deviation	0.72	0.3

Figure 87. Carbon and nitrogen ratios for adults at the Orton Cemetery.

Vaults 2 and 3 being almost identical. The means are almost identical to the results obtained by France and her colleagues, clearly indicating diets of high status individuals. The similarity of results among the four individuals may also indicate very little dietary variability, consistent with all of the individuals eating a very similar diet.

The results are similar to those obtained by Ubelaker and Owsley (2003:137) for late seventeenth century Chesapeake skeletal remains associated with a tobacco plantation. While hardly analogous with Orton, the findings are interpreted by Ubelaker and Owsley to represent a population with a lifelong diet that included substantial quantities of maize (although not as substantial as many late Native American groups).

The δ^{13}C mean of -15‰ suggests a surprising low reliance on marine foods, such as fish or oysters. The level is, however, consistent with the consumption of large quantities of beef, which Reitsema and her colleagues (2013) found from Charleston archaeological sites to have a δ^{13}C mean of -14.9‰.

The δ^{13}N mean of 11‰ is suggestive of maize, supplemented with perhaps small quantities of fish.

These findings are not unique and they tend to confirm what seems reasonable based on previous archaeological investigations. Nevertheless, the results reveal the benefits of this line of research, as well as the difficulty that can be encountered in making reasonable interpretations. Access to a wider variety of colonial North Carolina populations, coupled with analysis of carbon and nitrogen isotopes for a range of food resources in the area would help expand research potential.

Bone Lead Levels

Background

As briefly discussed in our Methodology section, bioanthropologists in America have used lead analysis to study social differences since at least the early 1980s when Aufderheide and his colleagues (Aufderheide et al. 1981) examined lead ingestion by two social groups (plantation owners and plantation labors, including both African American slaves and indentured white servants) at the Cliffs Plantation in colonial Virginia.

The sample included five whites found in the planter's cemetery, including both males and females, as well as children. There were an additional 11 burials thought to represent laborers, including primarily African Americans, and both males and females. They found that the plantation proprietors had lead levels more than five times greater than those who worked on the plantation. Table 18 reveals this difference.

Table 18.
Lead Levels from the Cliffs Plantation burials (adapted from Aufderheide et al. 1981: Table 1).

	Age	Sex	Race	Mean Skeletal Lead (ppm)	
Proprietors					
	5	M	W	144	
	4	F	W	226	
	31	M	W	128	
	37	F	W	170	
	32	M	W	258	
					185.2
Laborers					
	22	M	B	22	
	43	M	B	28	
	31	M	W	29	
	18	F	B	96	
	39	M	B	46	
	33	M	B	40	
	27	M	B	22	
	22	M	B	20	
	10	M	B	8	
	26	F	B	25	
	58	F	B	45	
					34.6

Aufderheide (Aufderheide et al. 1985) subsequently examined four additional colonial samples. These included 24 enslaved African Americans buried at Catoctin Furnace, an iron works in Maryland; 17 free African Americans from the College Landing Site in Virginia; 23 burials of whites associated with rural plantation agriculture at the Governor's Land sites; and 29 white burials associated with Rae's Hall Plantation in Georgia.

The enslaved blacks at Catoctin Furnace produced lead levels ranging from 0 to 233 µg Pb/g ash, with a mean of 38 µg Pb/g ash. The free blacks at the College Landing sites yielded an average of 41 and a range from 10 to 93 µg Pb/g ash. Thus, there is some suggestion that free blacks might have had greater access to either pewterware or to foods that had been preserved or prepared in high lead vessels.

The whites at Governor's Land show a range of lead levels from 5.7 (a 29 year old male) to 264.8 (a 43 female). The mean lead levels are 79.5 µg Pb/g ash. While relatively low compared to the levels encountered in some individuals, it is still higher than the mean for any of the African American populations.

The burials from Rae's Hall Plantation reveal a similar wide range, from 4.9 to 183.8 µg

Pb/g ash, with a mean of 60.3.

Aufderheide and his colleagues conclude, based on Rae's Hall Plantation that not all colonial white farmers were sufficiently successful to "indulge in the affluent practices leading to high lead absorption" (Aufderheide et al. 1985:361).

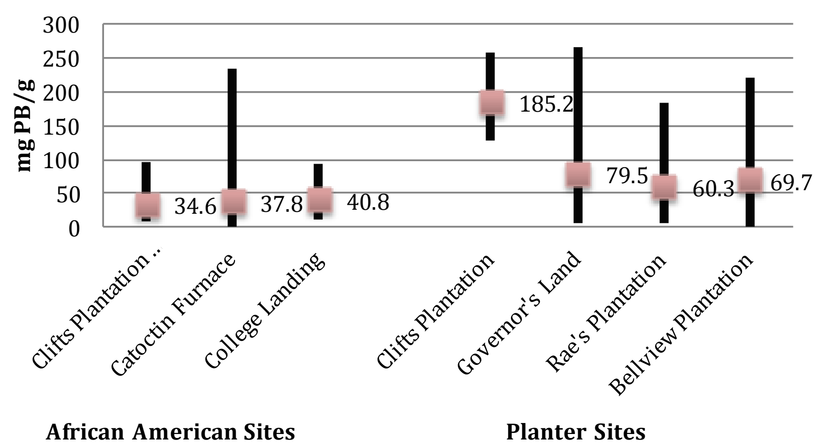


Figure 88. Comparison of lead levels at a variety of sites cited in the discussions.

More recently Rathbun and Scurry (1991) examined 13 burials from Bellview Plantation in Charleston County, South Carolina. Eleven of these were of whites, thought to be associated with the colonial Crofts family. While perhaps not as political connected or as wealthy as Roger Moore, Edward Croft was a planter, merchant, and Indian trader. He owned additional property in Georgetown and Beaufort, held a pew at St. Philip's Church in Charleston, and was active in politics. The results of the lead analysis for documented white burials produced a mean of 69.7 µg PB/g ash – higher than the levels documented for any of the African American samples and within the previously established ranges for white populations.

Figure 88 is interesting since it suggests there is less variability in the mean for lower status individuals during the colonial period, whether slave or free, than for colonial planters. Since lead levels are related to the lead sources in the planter's dwelling and those sources are likely tied to economic position, it is reasonable that there is considerable variability among the planter class. Nevertheless, lead levels, on average, tend to be higher among all planters, regardless of their status.

Effects of Lead

Lead affects at least three major organ systems: (1) the central and peripheral nervous systems; (2) the heme biosynthetic pathway; and (3) the renal system.

Clinical manifestations of lead differ somewhat between children and adults. In the child, the most serious symptoms are found in the central nervous system with subtle effects, such as decreased IQ and cognitive effects, occurring at lower levels and severe effects, including seizures and encephalopathy, occurring at higher levels.

Children tend to more sensitive than adults to the neurocognitive and behavioral effects of lead. Children absorb 40 to 50% of dietary lead whereas adults absorb about 10%; in addition, the nervous system develops rapidly in the young child (Lowery 2010).

Many of the risks for adults focus on women. At levels of about 200 ppm there is possible spontaneous abortion, possible postnatal developmental delay, and a risk of reduced birth weight in successful pregnancies. There are also risks of hypertension and kidney dysfunction (Kosnett et al. 2007). By 300 ppm it is possible to exhibit neurocognitive deficits as well as various nonspecific symptoms such as headache, fatigue, sleep disturbance, anorexia, constipation, arthralgia (joint pain), and myalgia (muscle pain). At least one research project found that lead significantly affects cartilage as well, convincingly associating knee osteoarthritis and elevated lead levels (Nelson et al. 2011). This appears distinct from the rheumatologic entity known as saturine gout, where the excretion of urate is inhibited, causing a build up in knee joints. Acute attacks of saturnine gout are frequently polyarticular and tophi rarely develop.

The skeletal pathology of gout, including saturine gout, are described by Aufderheide and Rodriguez-Martin (1998:110) and Ortner (2003:583-584). Most common is pressure erosion as a result of para-articular tophi. The bone develops "scooped-out" areas near the articular surface.

Orton Samples

We have previously observed that the soil at Orton has a very low lead level of 12 ppm with a nearly neutral pH. The water from shallow aquifers in the area are <3ppb. Consequently soil and water have made little or no contribution to the total lead uptake in the skeletal remains.

Table 19.
Lead Levels from Orton Burials

Sample	Bone	Age	Sex	µg Pb/g Ash
Vault 1, Individual A	vertebra	45-60	F	190
Vault 2, Individual A	femur	15-20	M	340
Vault 3, Individual B	vertebra	40-45	F	190
Vault 4, Individual A	rib	50-60	M	300
Mean for males	320			
Mean for females	190			

The analysis of the Orton samples was conducted using ICP-MS by Elemental Analysis, Inc. in Lexington, Kentucky. The results of the work are provided in Table 19.

These levels exceed those from any previous studies, with the difference between males and females suggesting differential access, even among the wealthy elite. The lead levels identified in the small sample of Orton burials reveals very high levels that we assume are representative of very high social status among the coastal elite.

Although Roger Moore's will (Grimes 1912:310) specifically mentions "plate," typically silverware, there is no mention of pewter dishes, storage vessels, or even wine. There is little archaeological evidence for lead-glazed ceramics or abundant wine bottles at Orton. Thus, we can only guess at the sources for these elevated lead levels. While the Orton skeletal samples document elevated lead levels, we did not encounter evidence of saturine gout in the skeletal remains.

Orton produced only one intact skull, from Vault 4, and this individual is thought to be "King" Roger Moore. Although there are several renderings of Maurice Moore (See Figure 89 for one example), the brother of Roger Moore, no painting of Roger Moore has been identified. Consequently, a forensic facial reconstruction was conducted by forensic artist and sculpture Roy Paschal. Paschal is retired from the South Carolina Law Enforcement Division where he was a forensic artistic and he has taught facial reconstruction at the FBI Academy, Quantico, Virginia.

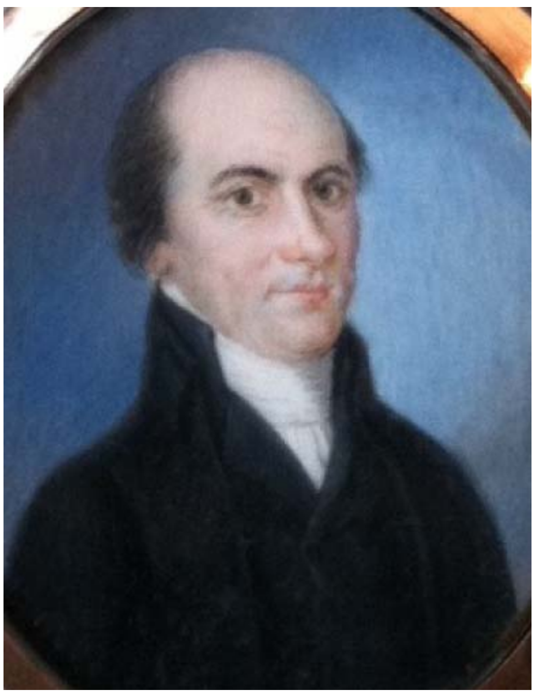


Figure 89. Miniature portrait (date unknown) of Maurice Moore acquired by Louis Moore Bacon from the NC Colonial Dames/Burgwin Wright House Museum.

Facial Reconstruction

Facial reconstruction is a method used in forensic anthropology to aid in the identification of skeletal remains. The reproduction of the facial features of an individual is based upon the average soft tissue thicknesses over various anatomical sites of the skull and jaws using what are known as "depth markers" placed at critical osteological points.

There are, however, a variety of methods that have been developed in different countries. For example, there is the "Russian Method" developed by M.M. Gerasimov and the "Manchester Methods," developed in Great Britain. Work in the United States can largely be traced back to the pioneering efforts of Dr. Wilton M. Krogman (Krogman 1946).

Since that time much of the focus has been on the location of tissue depth markers and, perhaps more importantly, the variations of the depth. Significant differences in the thicknesses of the soft tissues of males and females of different races has been reported (Gatliff and Snow 1979; Lebedinskaya et al.1993; Phillips and Smuts 1996; Rhine and Campbell 1980; Rhine et al.1982; Stewart 1954; Suzuki 1948). In addition, various techniques have been employed to measure the thickness of the facial tissues of adults, children, and young adults (Altemus 1963; George 1987; Heglar 1980; Lebedinskaya et al. 1993; Phillips and Smuts 1996).

Recently, however, Carl Stephan and Ellie Simpson published tissue depth data derived from a much larger sample than had been available before, incorporating published studies spanning 120 years (Stephan and Simpson 2008). One conclusion from this new research was that there are only minor differences in male and female tissue depths. They acknowledge that males have have thicker tissue depths in the brow and jawline, and females have more cheek tissue. But these differences were so minor that they didn't necessitate separate tables. In addition, they pooled ancestry data, noting that there had been no explicit criteria for assigning people into different "racial" groups. In addition, they observe that in many forensic cases the ancestry of the individual has not been documented in any event.

An example comparing the depth markers of Rhine and Campbell (1980) and Rhine and Moore (1984) with those of Stephan and Simpson (2008) is shown as Figure 90.

Regardless of technique, virtually all authors concur that the process blurs the lines between art and anatomy and a great deal depends on the ability of the forensic artist to interpret and adjust for specific features and concerns (Wilkinson 2010). While many features of facial morphology can be readily determined based on musculature and tissue depth, other features, such as lips and ears, require artistic interpretation.

			Tissue Thicknesses in mm (Stephan/Simpson)	Tissue Thicknesses in mm (Rhine/Campbell/Moore)	Caucasian		Af. American	
					male	female	male	female
median points (cut 1 marker)								
op	(1)	opisthocranion	6.50	-	-	-	-	-
v	(2)	vertex	5.00	-	-	-	-	-
	-	supraglabella	-	1	4.25	3.50	5.00	4.50
g	(3)	glabella	5.50	2	5.25	4.75	6.25	6.00
n	(4)	nasion	6.50	3	6.50	5.50	6.00	5.25
mn	(5)	mid-nasion	4.00	-	-	-		
rhi	(6)	rhinion (end of nasals)	3.00	4	3.00	2.75	3.75	3.75
sn	(7)	sub-nasale	13.00	-	-	-		
mp	(8)	mid-philtrum	11.50	5	10.00	8.50	12.25	11.25
ls	(9)	labrale superius (upper lip margin)	11.50	6	9.75	9.00	14.25	12.50
li	(10)	labrale inferius (lower lip margin)	13.00	7	11.00	10.00	15.50	15.00
mls	(11)	mentolabial sulcus (chin-lip fold)	11.00	8	10.75	9.50	11.75	12.25
po	(12)	pogonion (mental eminence)	11.00	9	11.25	10.00	11.50	12.50
gn	(13)	gnathion	8.50	-	-	-	-	-
m	(14)	menton (beneath chin)	7.00	10	7.25	5.75	8.25	8.00
bilateral points (cut 2)								
	-	frontal eminence	-	11	4.25	3.50	5.00	4.00
mso	(15)	mid-supraorbital	6.00	12	8.25	7.00	8.50	8.00
mio	(16)	mid-infraorbital	6.50	13	5.75	6.00	7.75	8.25
	-	inferior malar	-	14	13.25	12.75	16.50	16.75
	-	lateral orbit	-	15	10.00	10.75	13.25	13.00
z	(17)	zygomatic arch	6.50	16	7.25	7.50	8.25	9.50
	-	supraglenoid	-	17	8.50	8.00	11.00	11.50
go	(18)	gonion	10.50	18	11.50	12.00	13.00	13.50
sC	(19)	supra canine	9.50	-	-	-	-	-
iC	(20)	infra-canine	10.50	-	-	-	-	-
sM^2	(21)	supra M^2	24.00	19	19.50	19.25	23.00	20.25
mr	(22)	mid-ramus	17.50	-	-	-	-	-
mmb	(23)	mid-mandibular border	10.50	-	-	-	-	-
	-	occlusal line	-	20	18.25	17.00	19.00	19.25
iM_2	(24)	infra-M^2	18.50	21	16.00	15.50	16.50	17.00
acp	(25)	alare curvature point	9.50	-	-	-	-	-

www.askaforensicartist.com - Adapted from Stephan and Simpson, 2008; Rhine and Campbell, 1980; Rhine and Moore, 1984

Figure 90. Comparison of two tissue depth marker guides, courtesy of http://www.askaforensicartist.com/2011-tissue-depth-data-from-drs-stephan-and-simpson/.

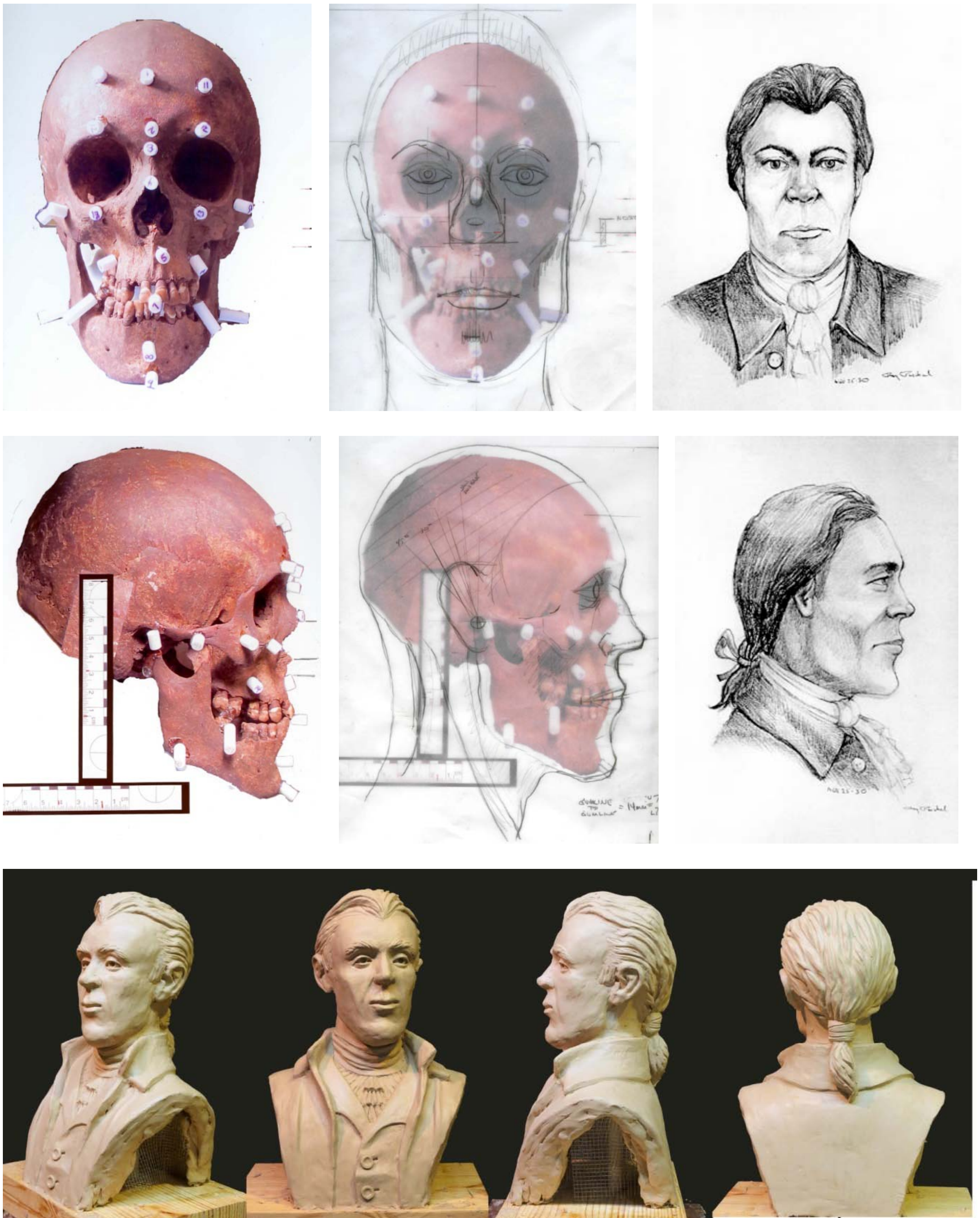


Figure 91. Two and three-dimensional renderings of the individual in Vault 4 thought to be Roger Moore.

Two of the most common texts outlining the methods of facial reconstruction are those by Karen T. Taylor (2000) and Caroline Wilkinson (2010).

Roger Moore

In the case of Roger Moore the first effort was a two-dimensional rendering using tissue depth markers and photo overlays (Figure 90). Subsequently a three-dimensional bust was created in clay, using a cast of the original skull using dental alginate. Between the two renderings adjustments were made in the depth markers to reflect pre-twentieth century dietary conditions, providing a somewhat more gaunt face.

Comparison can be made between Figure 90 and Figure 89. Both show a long, linear face, sharp jaw, and an especially sloping, bulbous nose – family traits that appear very recognizable. The most dissimilar feature is the hair, which of course cannot be ascertained from skeletal remains. Nevertheless, the various renderings of Roger Moore show the individual at the age of 25 to 30 years, while Maurice Moore is shown far later in life.

Conclusions

While necessitated by efforts to repair and stabilize the vaults, the Orton Cemetery provided an unparalleled opportunity to explore mortuary practices during the mid- to late-eighteenth century in coastal North Carolina, as well as to better understand the people associated with Orton, most especially Roger Moore. Opportunities for such work are rare, making the research at Orton all the more critical.

Vault Construction

Litten distinguishes a vault from a brick-lined grave by noting the former has a subterranean chamber capable of housing at least two coffins side by side, while the latter encompasses anything narrower (Litten 1991:207). Using this definition, the Orton tombs are most certainly vaults.

They are of brick construction, sized for two coffins (although more could be stacked), are semi-subterranean, and have either arched roofs or gable set on arched roofs. They are oriented east-west with either squared or arched entrances at one end. Exteriors were stuccoed; interiors had low knee walls to support coffins and had bricked floors, but were otherwise unfinished.

There is evidence that the brick was laid up from within the vaults, leaving little evidence of a builder's trench. Floors were crudely laid, as were coffin rests or supports. In addition, wooden arched supports were added, what Litten (1991:217) calls shuttering, allowing the barreled roof to be constructed from outside the vault. Once the mortar was sufficiently cured, this wood framework was removed and end walls were built up.

Although North Carolina cemeteries reveal a variety of family vaults, as well as the even more common brick-lined graves, we have not been successful in finding close proxies to the Orton vaults in the immediate area. This is certainly surprising since Litten comments that such family vaults with barreled roofs were often used by the landed gentry (Litten 1991:211).

Vaults similar to those at Orton are found in neighboring South Carolina and extending into Georgia. There are few similar vaults to the north into the Middle Atlantic or Northeast, perhaps suggesting that these brick vaults are associated with Anglicans, perhaps from the Barbados. Harold Mytum (personal communication 2015) makes a very different suggestion, noting that vaults similar to those at Orton were used by wealthy Irish families. Since Roger Moore traced his lineage to Nathaniel O'Moore (1620-1680), there may be good reason for the similarities.

Regardless, the Orton vaults are all thought to date from the mid-eighteenth through perhaps early nineteenth century, providing some of the earliest mortuary architecture documented for the region.

Dating the Vaults

Since all of the remains were apparently interred in shrouds, there are no clothing items that might help refine burial dates. All of the coffins and coffin furniture are very similar and while clearly eighteenth century in origin, none can be more precisely dated.

Consequently, our efforts to date the construction or use of the vaults turned to AMS dating of either coffin wood or skeletal remains in the hope that this procedure would help unravel construction episodes. Initial efforts using the more expendable wood met with very little success and therefore the research was expanded to incorporate small bone fragments. All of the dates were hindered by the presence of "wiggles" in the calibration data. This resulted in multiple possible dates for almost every sample. In most cases, many of the dates were clearly incorrect, reflecting ranges long before or long after Orton was occupied by the Moore family. For this brief review we have selected the most probable 2 sigma range from each sample and these are shown in Figure 92.

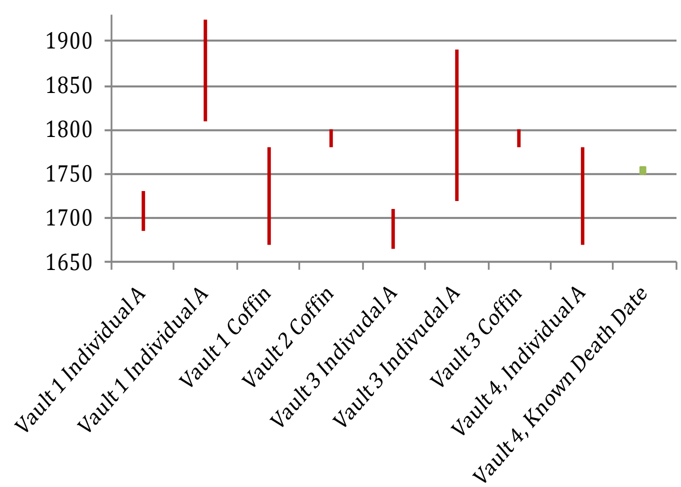


Figure 92. Comparison of AMS dates from Orton vaults.

In the case of Vault 1, there are two possible date ranges for the skeletal remains. The date obtained for the coffin wood excludes the later skeletal date, suggesting a use date closer to 1685-1730. This would be early in Roger Moore's tenure.

Vault 2 was dated using only coffin wood, suggesting a date at the end of the eighteenth century. We have previously suggested that this late date may explain the vault's location out of main row and closer to the marsh.

Vault 3 produced two skeletal dates and one date for the coffin wood. The coffin wood is incorporated with the later of the two skeletal dates, also suggesting a late eighteenth century date. In contrast, our genealogical and DNA research suggests that Catherine Rhett, who died in 1745, may be buried in this vault. If this is correct, then Vault 3 predates Vault 4.

Finally, while Vault 4's AMS date obtained from the bone does include the known death date of 1751, there is very little precision.

As a result, only Vaults 3 and 4 can be dated with any degree of certainty and this is only because we believe that they house individuals with known death dates (Catherine Rhett, who died in 1745, in Vault 3 and Roger Moore, who died in 1751, in Vault 4). These two vaults suggest that construction was proceeding from the north to the south, meaning that Vault 1 may be earlier than 1745, potentially consistent with both skeletal and coffin wood dating. Vault 2, out of alignment may in fact represent a very late addition to the cemetery – and this is consistent with the coffin wood date.

We acknowledge that this dating is precarious at best, but it seems reasonable and offers at least one potential reconstruction of how the Orton Plantation cemetery developed: Vault 1, Vault 3, Vault 4, and Vault 2, with the below ground burials of more distantly related individuals continuing to the south into the nineteenth century.

Coffins and Coffin Hardware

There is ample literature concerning coffin shapes and construction, primarily from Great Britain. In terms of archaeological evidence, there has been considerable research, again in England, but also in the Northeast and Middle Atlantic. Research in the Southeast, and particularly in the Carolinas, has been very sparse and focused on the nineteenth century. Consequently, the information obtained from Orton is of special interest and relevance.

All of the coffin wood from Orton was identified as pine (*Pinus* sp.). While this is certainly reasonable considering the historical importance of naval stores generated by longleaf pine in this vicinity, pine is often viewed as a low-status wood. Nevertheless, it was the only wood used by the Moores in burying their dead.

All of the coffins identified were hexagonal with flat tops. In this category, however, we identified two variations. In one case the breaks were sharp, while in the second case the breaks were flowing or more graceful (compare Figures 22 and 68). By the nineteenth century (Plume 1902) these were distinguished as the "old familiar type, which have obtained from time immemorial" identified by the "sharp bend at the shoulders" and a style from Lancashire, characterized as "much improved . . . both in appearance and utility" with a "gradual curve from the head to slightly past the shoulders" (Plume 1902:71).

Although Litten (1991:90) suggests the Lancashire style likely did not come into use until the second quarter of the nineteenth century, the recovery of certain Lancashire features from a 1751 burial suggests the style may not be as new as thought. Nevertheless, we have not identified the style being identified in eighteenth century contexts (see, for example, Riordan 2009:82).

Since this style is somewhat more difficult to construct, we have suggested that it was purchased, reflecting the skills of a local Brunswick carpenter or furniture maker. In contrast, the other coffins may reflect manufacture on the plantation by slave carpenters.

In other respects, however, the coffins at Orton all appear to be very typical of other eighteenth century examples. The corners were neither mitered nor dove-tailed; rather they were butt-jointed. They were constructed with hand wrought nails, typically 1½ to 2½-inches in length (4d to 8d). The location of these nails could not be determined given the condition of the wood remains in the four vaults.

In at least one case we identified a textile impression preserved in metal corrosion. The fabric is thought to have been an interior lining, although it is possibly the shroud itself. The impression suggests a very finely woven textile, perhaps linen. Otherwise, the common presence of iron tacks suggests that the coffins had some sort of lining. None of the wood preserved painting, although it was common to blacken the exteriors. We failed to find any evidence that the coffin interiors were sealed with pitch to prevent seepage.

All of the coffins appear to have made use of brass tacks, although the coffin attributed to Roger Moore was very sparsely decorated, so this feature may be more commonly used for women. The tacks ranged from 5/16 to 7/16-inch in size and were typically placed in bands or rows around the edge of the coffin lid. At least a few preserved specimens, however, are suggestive of decorations or even letters.

While seventeenth and eighteenth century coffin handles are documented at Northeast and Middle Atlantic cemeteries, we have not found examples from North Carolina.

Coffin handles were present for the Orton burials and all were wrought iron mounted on backplates. The styles are all very similar and it is unclear if they were specifically designed as coffin handles or if they were furniture handles adapted by local craftsmen. Roger Moore's coffin, however, used mismatched handles, suggesting his death occurred when the local furniture maker had only a limited stock.

Many of the backplates found at Orton had stamped designs, including those found in Roger Moore's tomb dating to 1751. These represent items manufactured by placing a sharp edge die on the metal and hammering to emboss the sheet – the technique that would have been used prior to Pickering's 1769 invention of a machine to perform this task.

Shrouds

All of those buried at Orton went to their grave in a shroud, as was typical of the period (see, for example, Litten1991). The pins associated with several vaults were likely used to attach caps or face veils, rather than to close shrouds, which were usually tied or knotted. No articles of clothing were recovered in any of the vaults.

Skeletal Remains

Exhumation of skeletal remains from the four vaults at Orton revealed the presence of 11 individuals: one adult male, two adult females, one teenaged male, and seven infants (two males, four females, and one of unknown sex).

Individuals

Individual A in Vault 4, was an adult male of Caucasian or European descent, aged 50 to 60 years at death. He stood between 5’4” and 5’10”, and was born with a severe case of spina bifida occulta, which may have caused moderate to severe leg or back pain throughout his life. He had a slight to moderate hunch of the upper back, and suffered from several herniated disks, which may have been the result of age, repetitive use, or the spina bifida occulta. Morphological analysis indicates that he was right handed, and walked enough distances in his life to cause rugged leg musculature and arthritis, as well as a bone spur on his right heel. Rugged musculature of the right arm and wrist also indicate that he walked with the assistance of a walking staff. Although he lost a lower incisor in his childhood or early adolescence, the surrounding teeth moved in to close the gap completely, creating a straight, ungapped smile. Four molars had been lost to wear and decay many years before his death, but he had only four small cavities in his remaining teeth. Bony changes in his ribs seem to indicate that as an adult, he suffered from an unspecified lung condition, which caused consistent coughing or difficulty breathing. The parasite and pollen studies indicate that he ate a full meal of meat and cultivated cereals within hours of his death. As no other medical conditions were noted, it is likely he died suddenly.

Individual A, Vault 1**,** was an adult female of European descent, between the 45-60 years old at death. Her maximum height would have been between 5'1 and 5'5", and her teeth were in very good condition. This individual probably suffered back pain or weakness due to osteoarthritis in the spine. She suffered from a mild to moderate case of spina bifida occulta that does not appear to have altered her spinal shape or posture, although she appears to have favored her right leg, thus walking with a small limp, since childhood.

Individual A, Vault 3, was an adult female of European descent, between the 40-45 years old at death. Her maximum height would have been between 5'6" and 5'7" . She appears to have spent a significant amount of time in a kneeling position, as well as walking and standing. Similar kneeling facets on the metatarsals of an adult female were found at the Patuxent Point, containing 17th century burials (Ubelaker et.al. 1996:61). She may have suffered mild to moderate discomfort from arthritis in her back and ankles.

Individual A, Vault 2, was an adolescent male of European descent, between the ages of 15 and 20 years at death. He would have had a maximum height of 5'5" to 5'6", but gracile, with a straight toothed smile. All incisors showed wear on the edges, exposing a line of dentin on each, indicating heavy biting use. Multiple cavities were present, on seven molars and four premolars; the largest cavities, and likely most uncomfortable, were on the maxillary right first and second molars and left first and second molars. These cavities were only on the buccal surfaces, perhaps from pockets of food or sweets being held between the upper cheek and teeth for periods of time. He suffered from a severe case of spina bifida occulta, which may have caused moderate to severe leg or back pain throughout his short life. As a result of this genetic condition he likely sat and walked with his back twisted, thrusting his left shoulder down and his right shoulder up and forward, and perhaps with a slight limp.

Individual W, Vault 2, was an infant or child between the ages of 6 and 18 months at death, sex unknown. If this child was walking, it likely had a characteristic "pigeon-toed" walk, due to the rotation of the femurs. There was no indication of disease or injury.

Individual X, Vault 2, was a female infant between the ages of 12 and 18 months at death. Her smile would have been distinctive, showing cavity lines across the four upper central incisors, due to being "bottle fed" between the ages of 8 - 16 months.

Individual Y1, Vault 2, was a female infant between the ages of 12 and 24 months at death. Her smile would have been distinctive, showing a brown upper incisor due to being "bottle fed" between the ages of 8 - 16 months. The extensive decay in the upper incisors may have caused considerable discomfort, resulting in a very cranky, crying infant.

Individual Y2, Vault 2, was a male infant, between the ages of 6-18 months at death; there was no indication of disease or injury.

Individual Z1, Vault 2, was a female infant between the ages of 16 and 32 months at death. The decay in the lower left molar may have caused considerable discomfort, resulting in a very cranky, crying infant and possible difficulty in eating solid foods.

Individual Z2, Vault 2, was a male infant, between the ages of 6-18 months at death; there was no indication of disease or injury.

DNA Results

DNA research indicated that six of these individuals were related.

Individual A, Vault 4, is likely “King” Roger Moore, the owner and developer of Orton Plantation. DNA research positively matched his Y-chromosome profile, or paternal line, to that of a living male direct descendant.

Individual A, Vault 1, is likely a sister of Roger Moore. The DNA analysis indicated these two individuals share the same maternal DNA, signifying they had the same mother.

Individual A, Vault 3, was not maternally related to any other individuals in the cemetery, and may have been Roger Moore’s second wife, Catherine Rhett Moore. An effort to prove this has been stymied by the inability to identify a suitable living descendant in the Rhett line.

The bone of Individuals A, X, Y1, and Z1 of Vault 2 provided for DNA analysis showed a maternal relationship with Individual A, Vault 1, who was probably their mother.

The bones of Individual W, Vault 2, and Individual Z, Vault 3, provided for DNA analysis did not show a maternal relationship with the other individuals in this cemetery, and were probably not members of the immediate family.

The bone of Individuals Y2 and Z2, Vault 2, provided for DNA analysis obtained no results, due to degraded conditions.

Thus it appears that indeed these burial vaults represent the Moore family cemetery, with the interment of Roger Moore, his adult sister and four of her children, an adult woman who may have been his wife Catherine, and four unidentified infants.

An effort has been made to confirm the identity of Individual A, Vault 3 as Catherine Rhett. Thus far, however, we have not been able to identify a female descendant for comparative purposes.

Bottle Feeding in the Colonial Era

There have always been only three ways to feed an infant: by breast-feeding with the mother, breast-feeding with another woman (wet-nurse), or with a prepared formula that replaces breast milk (hand-feeding). As today, colonial Americans believed that breast-feeding was the best method for infants, although only 20% of twenty-first century American women breast feed their children. In colonial America, virtually all women breast-fed their infants (Salmon 2001:250). So important was this maternal duty that research indicates that most colonial southern plantation mistresses breast-fed their own infants, as opposed to less than 85% of antebellum plantation mistresses (McMillen 1985:334). An authority in the early antebellum wrote:

> The mother's milk is the only proper nourishment. Nothing but the most imperious necessity should induce a departure from this obvious rule of nature. The healthiest children are those who for six months at least were never fed with any other substance" (Child 1837:35).

Unfortunately, there were a variety of factors that could prevent a colonial mother from nursing, including death, serious illness, extreme fatigue, or breast infections. Frequently, breast-feeding could be done in conjunction with wet-nursing or hand-feeding, and in many cases, when the mother regained her health, returned to sole breast-feeding (Golden1996:20). Maternal mortality rates in the southern colonies were higher than in the north, as high as 20 per 1000 in areas of endemic malaria (Golden 1996:19); by the 1850 census, 3.8% of white women's deaths in North Carolina were due to childbirth, twice the rate of New England states (McMillen 1990: 81).

The first choice in alternate nursing was the use of a wet-nurse, preferably a friend or relative (Caulfield 1952:674). Wet-nurses were also available for hire in the larger towns and cities, to the point that some historians believe that in the eighteenth century, breast milk was the "most frequently advertised commodity in American newspapers" (Caulfield 1952: 677). Although many people believe that plantation mistresses used their female slaves as wet-nurses, there are few written references to this occurring (Caulfield 1952:680; McMillen 1985:335). *The Family Nurse* gave advice for choosing a wet-nurse:

> If, unfortunately, there is an absolute necessity of delegating to a stranger the sacred office of nurse, be careful that she is a healthy woman; under thirty-five years of age; free of humors; from intemperate, or gluttonous habits; and not violent in her temper. Her milk should be as near the age of her nursling as possible; it had better be younger than older (Child 1837: 39).

This last bit of advice reflects the common belief that after 12 months of nursing, the mother's milk "deteriorated in quality and quantity" (Child 1837: 37).

For a colonial mother with few neighbors or nearby relatives to act as wet-nurse, hand-feeding may have been a necessity. There were no commercially prepared formulas, and it was not until the 1880s that bottles and nipples were widely available (Wilkie 2003: 191). Instead, pap-boats, shaped like squat gravy boats or flattened bottles with openings on the top side, were used. These were made of silver, pewter, or ceramic, with a spout at one end to supply the formula, or pap, to the baby's mouth (Caulfield 1952: 684). The spout itself was not intended to fit in the baby's mouth, but rather a nipple made of sponge covered with a heifer's teat was tied to the spout; the nipple was placed in the mouth, and removed and cleaned after every feeding (Child 1837: 38).

The formula in a pap-boat was seldom the mother's expressed breast milk; a variety of recipes were available for women to follow, including the very simple: "two-thirds new milk, one third water, and a little loaf sugar; made fresh often, and given luke-warm . . . After several teeth have been cut, a little rice water . . . may be added to the preparation" (Child 1837: 36). One of the most popular formulas in the southern colonies was a "mixture of cow's milk, water, and brown sugar" (McMillen 1985: 349).

Sadly, there were men who also wrote formulas, which were much more complex; in 1776 Lionel Chalmers of Charleston, South Carolina recommended a broth of:

> any kind of lean meat, excepting pork, in which a few tops of parsley, and some grains of black pepper should be boiled . . . better not to thicken it at all, though a little salt may be added . . . . And when they are 8 or 10 months old, their broth may be thickened with the crumb of bread; and the latter may likewise be mixed with either the clear gravy of roasted lean meat, finely minced, chicken or veal once in a day. Neither should a sip of sweet wine (such as that of Malaga or Canary) or even of some distilled spirit well diluted with water, be denied them once or twice daily, more especially if they be weakly or much depressed by the heat of the weather . . . . The preposterous manner of feeding infants with pap, and other such indigestible food nauseatingly sweetened, is highly censurable at all times . . . . During the summer and autumn, sucking infants ought to be daily allowed a little spirituous drink oftener than once in this country. And experience proves, that no children thrive so well here as those who every day, sip either a small quantity of Canary or other sweet wine, mixt with an equal proportion of water. Or a little rum well diluted, at all seasons; and they might be accustomed to this, from the time they are four or five months old (Caulfield 1952: 686).

While clearly not sufficient nutrition for an infant, these formulas also carried the risk of illness. Without refrigeration, pasteurization, or knowledge of bacteria, the use of formulas was a risk at every feeding. Although there are no statistics for the colonial period, by the 1850 census 12% of children under the age of 1 year and 20% of children aged 1 to 5 years died of teething, dysentery, diarrhea or "cholera infantum."

Cholera infantum was well described in letters and journals of the colonial and antebellum parents, and was a severe intestinal disorder that often occurred during teething, and was endemic from late spring through early autumn, the hottest months in the south (McMillen 1985: 341).

"Cholera infantum" is an archaic word for gastroenteritis, and children don't die from "teething"; all four of these causes of death likely refer to the same symptoms: severe diarrhea, vomiting, headache, dehydration, fatigue and collapse. In other words, this is infantile gastroenteritis, likely caused by the ingestion of raw milk, or contaminated food or water. The hand-feeding formulas prepared with milk and water were the likely sources of the contamination, especially in the hot weather.

The treatment of cholera infantum included a bland diet, milk, and purging. Purging, or the emptying of the stomach and bowels, was accomplished with castor oil, calomel (Mercury (I) chloride or mercurous chloride), ipecac and opium; this treatment was recommended into the early twentieth century (Gunn 1840: 608; Kerley 1909: 202).

Today infantile gastroenteritis is still a common complaint, especially as infants begin teething, but is quickly and easily treated with hydration and electrolyte replacement.

Another side effect of hand-feeding was the introduction of large amounts of sugar onto the baby's teeth. The heavily sugared formula clung to the exposed tooth surfaces, and if not wiped off, led to decay of the surface of the tooth.

As noted here, Individuals X and Y1 of Vault 2 had decayed teeth in the pattern today called "bottle mouth"; tooth development indicated that at ages 8-16 months each was taken off breast milk and hand-fed. Whether or not they suffered from cholera infantum during hand-feeding is impossible to determine, although these infant females died at ages 12 to 18 months and 12 to 24 months, respectively.

Diet and Isotopes

Bone samples from adults in Vaults 1, 2, 3, and 4 were submitted for stable isotope analysis using the carbon isotopes ^{12}C and ^{13}C and the nitrogen isotopes ^{14}N and ^{15}N. The results formed two very tight clusters, with the results from Vaults 1 and 4 and Vaults 2 and 3 being almost identical. Moreover, the results are almost identical to those obtained by France and her colleagues (2014), indicating diets of high status individuals.

In particular, the results are suggestive of a lifelong diet that included substantial quantities of maize and low reliance on marine foods, such as fish or oysters, surprising in light of Orton's location on the Cape Fear River. The results also indicate the consumption of large quantities of beef.

Although these results are not unexpected, they point out the need for further research focusing on colonial North Carolina populations, coupled with analysis of carbon and nitrogen isotopes for a range of food resources in the area.

Parasitology

The burial of Roger Moore was the only one suitable for parasite analysis and it produced no evidence for any associated parasites (although stomach contents revealed a recent meal heavy in meat, consistent with the isotopic studies).

Many researchers, such as Reinhard (2001:163) take the position that "parasites were unavoidable" among European colonists. He believes that colonists encountered a "nexus of parasitic faunas from three continents: North America, Europe, and Africa." This, coupled with ignorance concerning the role poor sanitation played and the suitability of coastal environments for their survival, resulted in parasitism that Reinhard (2001:164) considers "common, perhaps ubiquitous." A review by Gonçalves and his colleagues (2003) similarly documents the prevalence of parasites through antiquity.

At Tazewell, the eighteenth century residence of John Randolph, no parasites were found in what was interpreted to be privy soil. Reinhard argues that the absence of parasites proves that the soil was likely not from a latrine setting. Efforts at the colonial beef market in downtown Charleston, South Carolina also produced little evidence of the "parasitism that certainly existed" (Reinhart 2005:181). However, even the Spitalfields project in London, conducting analysis on seventeenth and eighteenth century coprolites, found parasites in only half of the samples (2012:58).

The failure to encounter parasites in the remains of Roger Moore is strongly suggestive, although not conclusive, that he was in robust health and the plantation exhibited overall good sanitation.

Bone Lead Levels

Samples of the four adult Orton samples (Individual A from Vault 1, Individual A from Vault 2, Individual B from Vault 3, and Individual A from Vault 4) were examined for lead content using ICP-MS. The results, ranging from 190 to 340 µg PB/g ash, represent the highest we have identified in the reported literature. Males in the sample averaged 320 µg PB/g ash, while females revealed a lower mean level of 190 µg PB/g ash.

These results suggest that the Moore family was exposed to very high lead levels consistent with their high social status. The difference between males and females also suggests differential access.

Comparisons

The skeletal evidence suggests that the individuals interred in the Orton Cemetery were healthy and well nourished, with no evidence of trauma (with the exception of Individual A, Vault 4, having lost one tooth in childhood).

Table 20.
Comparison of the Orton Individuals with other Reported Populations
(adapted from Ubelaker et al. 1996:Table 30)

	Age at Death	Stature (cm)	Teeth Lost Antemortem	Carious Teeth	Abscesses	Enamel Lines	Ratio of Individuals with Pipe Wear	Spina Bifida Occulta	Schmorls' Nodes
Orton Female (Vault 1)	45-60	155-265	0	0.5	0	0	0	yes	yes
Orton Female (Vault 3)	40-45	168-171	na	na	na	n/a	na	no	ues
Orton Male (Vault 4)	50-52	163-180	4	5	1	0	0	ues	yes
Orton Male (Vault 2)	15-20	165-168	0	11	0	0	0	yes	no
Patuxent Females [1658-1690]	36	161	5.4	7	1.6	3.2	0.4	1	1
Patuxent Males [1658-1690]	31	170	2.7	4	1.7	2.2	0.67	-	0
Belleview Females	32	162	8	2.7	na	1.8	0	-	-
Belleview Males	30	170	6.3	1.8	na	4.3	0	-	-
Ft. Laurens, Ohio [1779] Males	23	173						-	1
Early Colonial 1619-1640 Females	28	158	3.8	1	0.1	2.3	0.22	-	-
Early Colonial 1619-1640 Males	33	169	1.7	2.1	0.2	2	0.33	-	-
Modern White USA Females	37	164	8	5.9	0.7	1.6	0	-	-
Modern White USA Males	43	173	11.7	4.1	0.6	1.6	0	-	-

When compared to other colonial populations (Patuxent Point, Belleview Plantation and Angel's "Early Colonial" collection), the individuals at Orton were extremely healthy. Of the adults, only Individual A, Vault 1, matched the mean height data; both other adults were taller than the other populations. The Orton adults were significantly older at death than the other groups, with better dental health.

Three related Orton individuals suffered from spina bifida occulta, probably congenital, yet appear to have led otherwise normal, active lives. The only evidence of disease was found in the ribs of Individual A, Vault 4, indicating an unspecified lung condition. The only evidence of possible maternal ill health is evidenced in the early weaning of two infants, resulting in tooth decay known as "bottle mouth."

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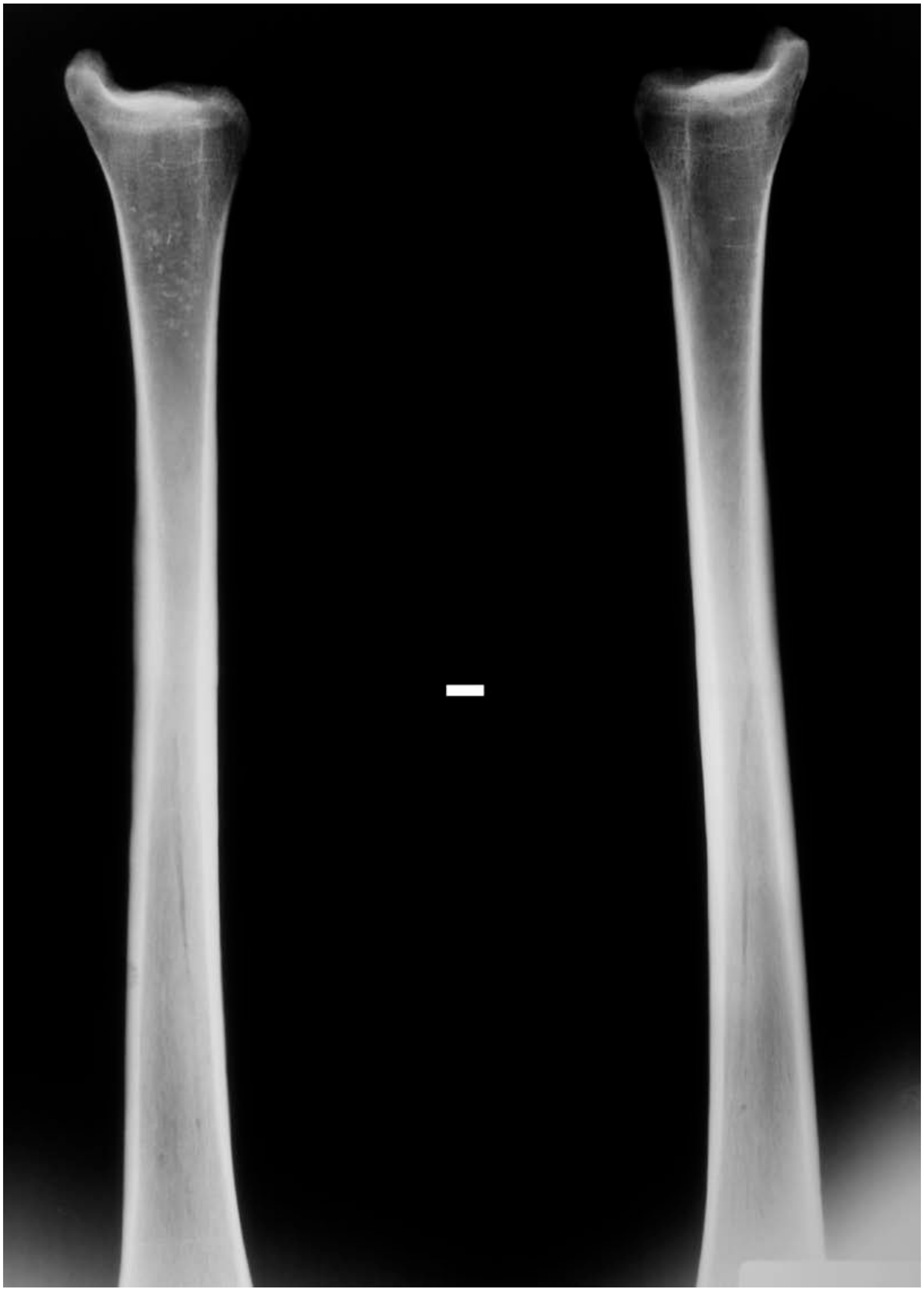
Appendix 1. Radiographs of Skeletal Elements

The analysis was supplemented with the radiometric documentation of long bones since such information can be useful for age determination, Harris line identification, pathology evaluation, and osteoporosis assessment. Bones were placed directly on the x-ray film and the cone was at 40 inches. All radiographs used the anterior-posterior orientation unless otherwise specified and exposure was typically 300MA, 50kV, 1/30 second. The white bar in the photos measures 1 cm.

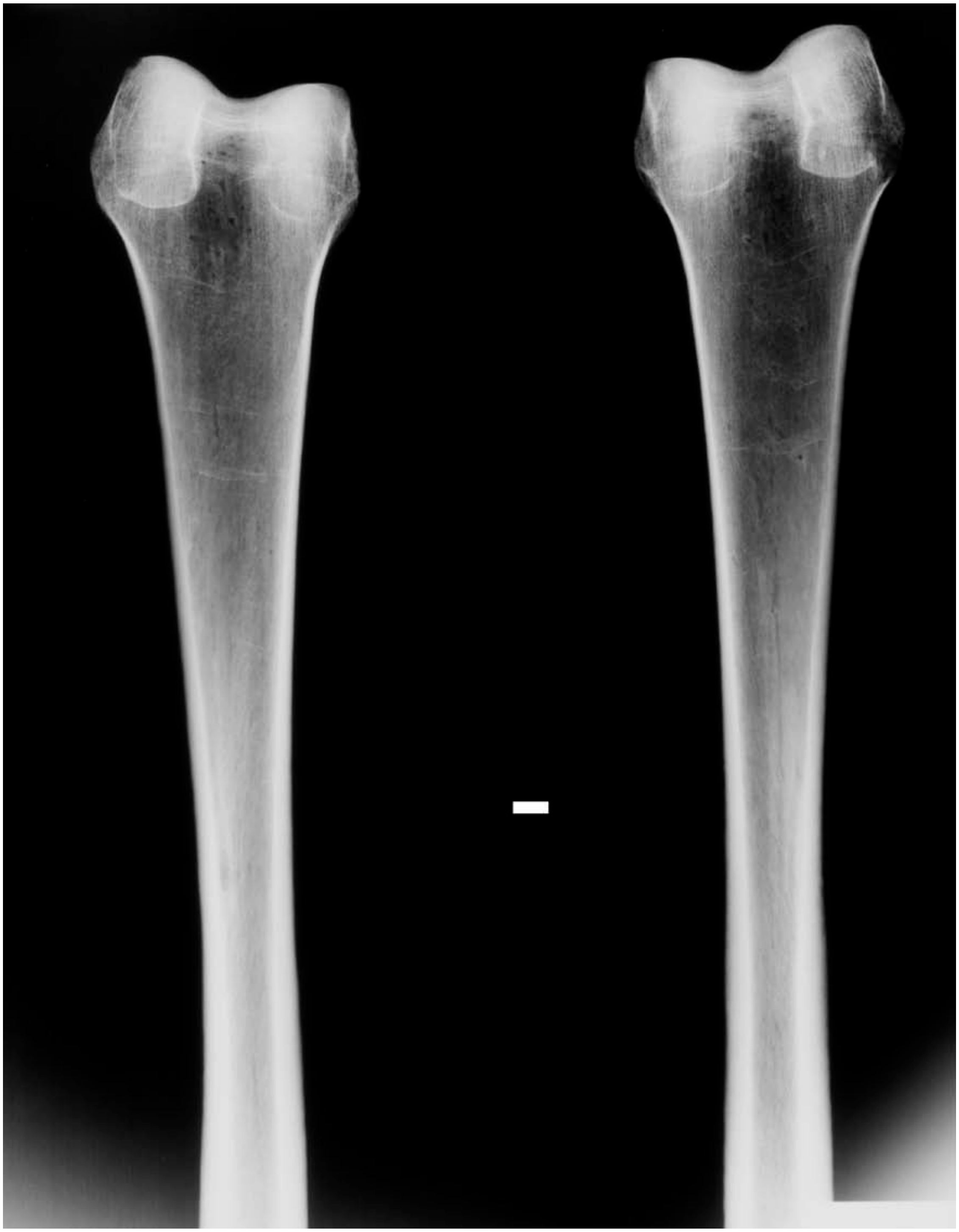
Appendix 1-1. Vault 4, Individual A, left humerus, radius, ulna, and clavicle.

Appendix 1-2. Vault 4, Individual A, right clavicle, radius, ulna, and humerus.



Appendix 1-3. Vault 1, Individual A, distal right and left humerus.

Appendix 1-4. Vault 1, Individual A, right proximal humerus, right ulna and radius, left proximal humerus.



Appendix 1-5. Vault 1, Individual A, right and left distal femur.

Appendix 1-6. Vault 1, Individual A, right and left proximal femur.

Appendix 1-7. Vault 1, Individual B, right and left proximal femur.

Appendix 1-8. Vault 1, Individual B, right and left distal femur, left clavicle.

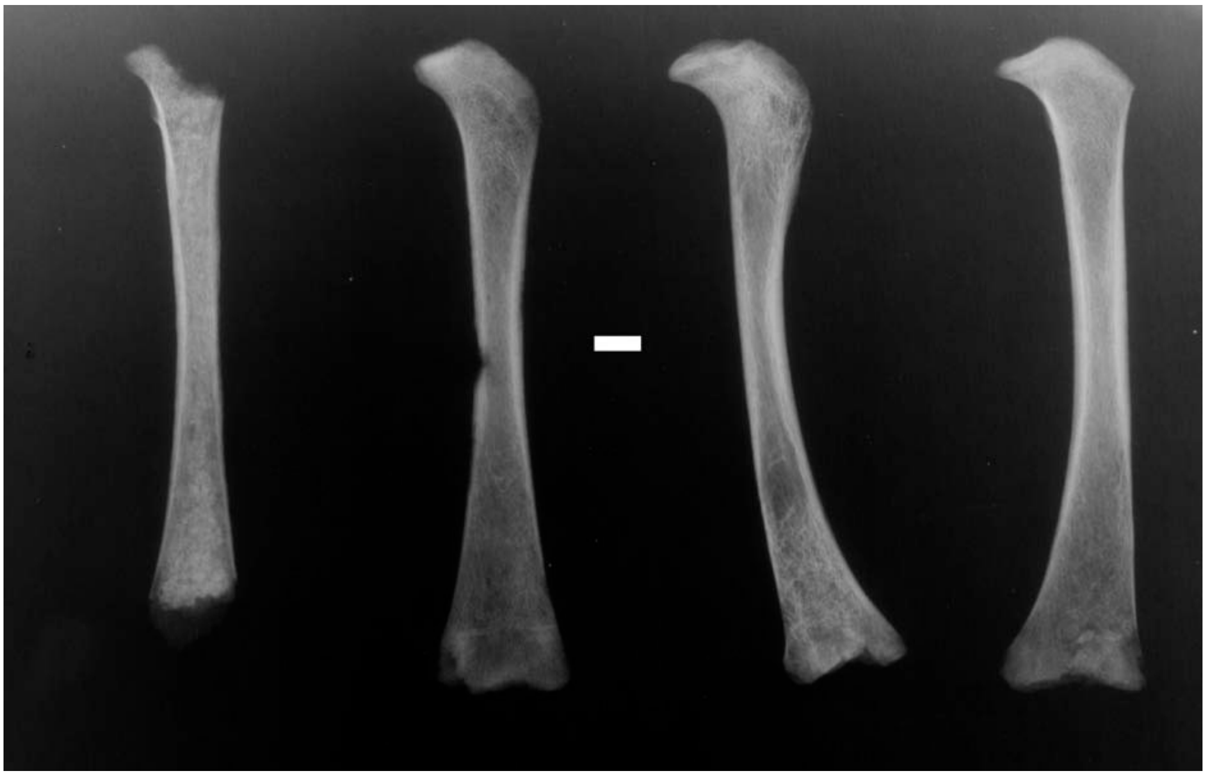
Appendix 1-9. Vault 4, Individual A, right proximal femur, tibia, and fibula.

Appendix 1-10. Vault 4, Individual A, right distal femur, tibia, and fibula.

Appendix 1-11. Vault 4, Individual A, left proximal fibula, tibia, and femur.

Appendix 1-12. Vault 4, Individual A, left distal fibula, tibia, and femur.

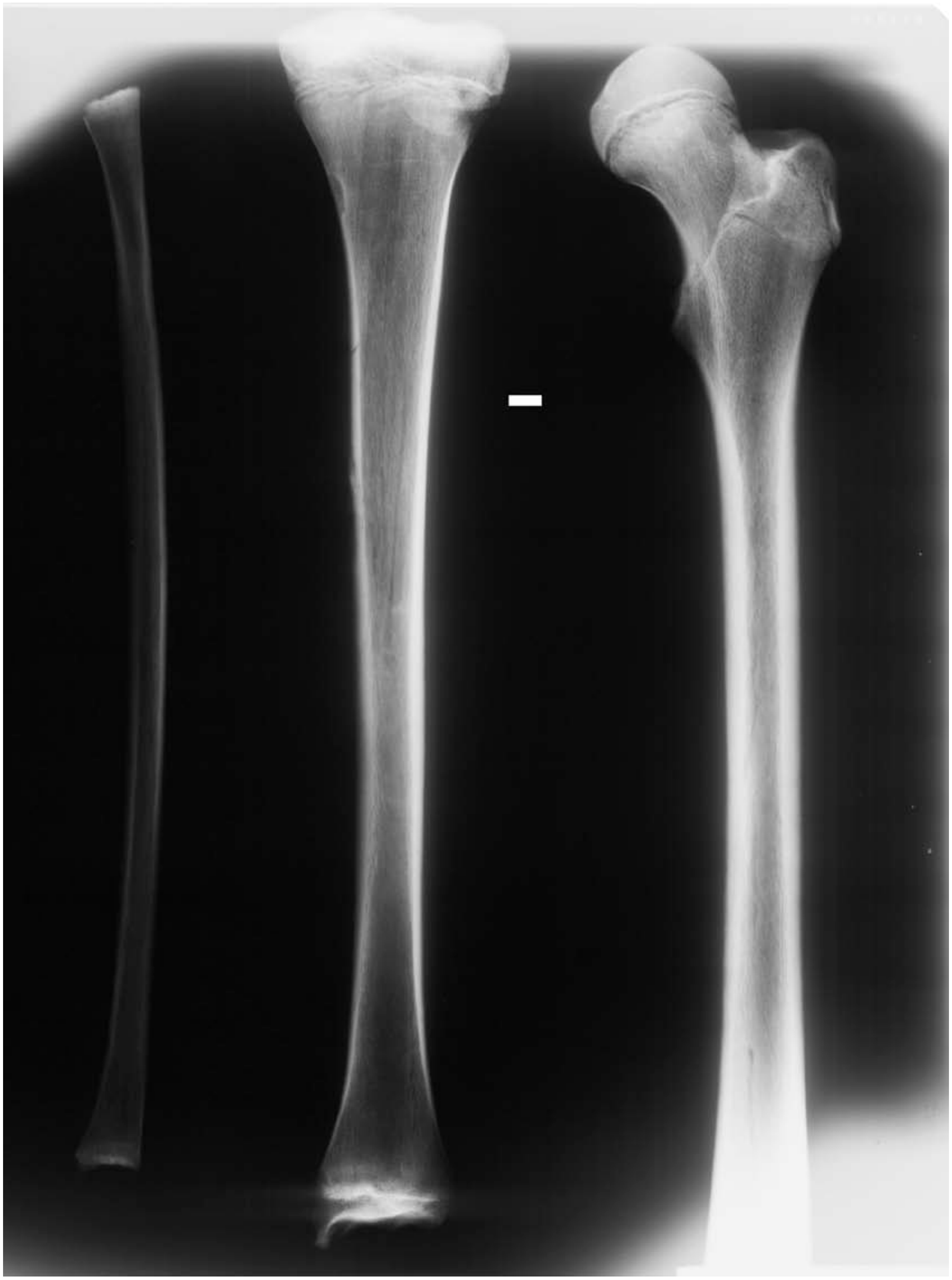
Appendix 1-13. Vault 4, Individual A, left and right humeri, distal end at top.



Appendix 1-14. Vault 2, Individuals W, X, Y, and Z, right femur.

Appendix 1-15. Vault 2, Individual A, right proximal femur, tibia, and fibula.

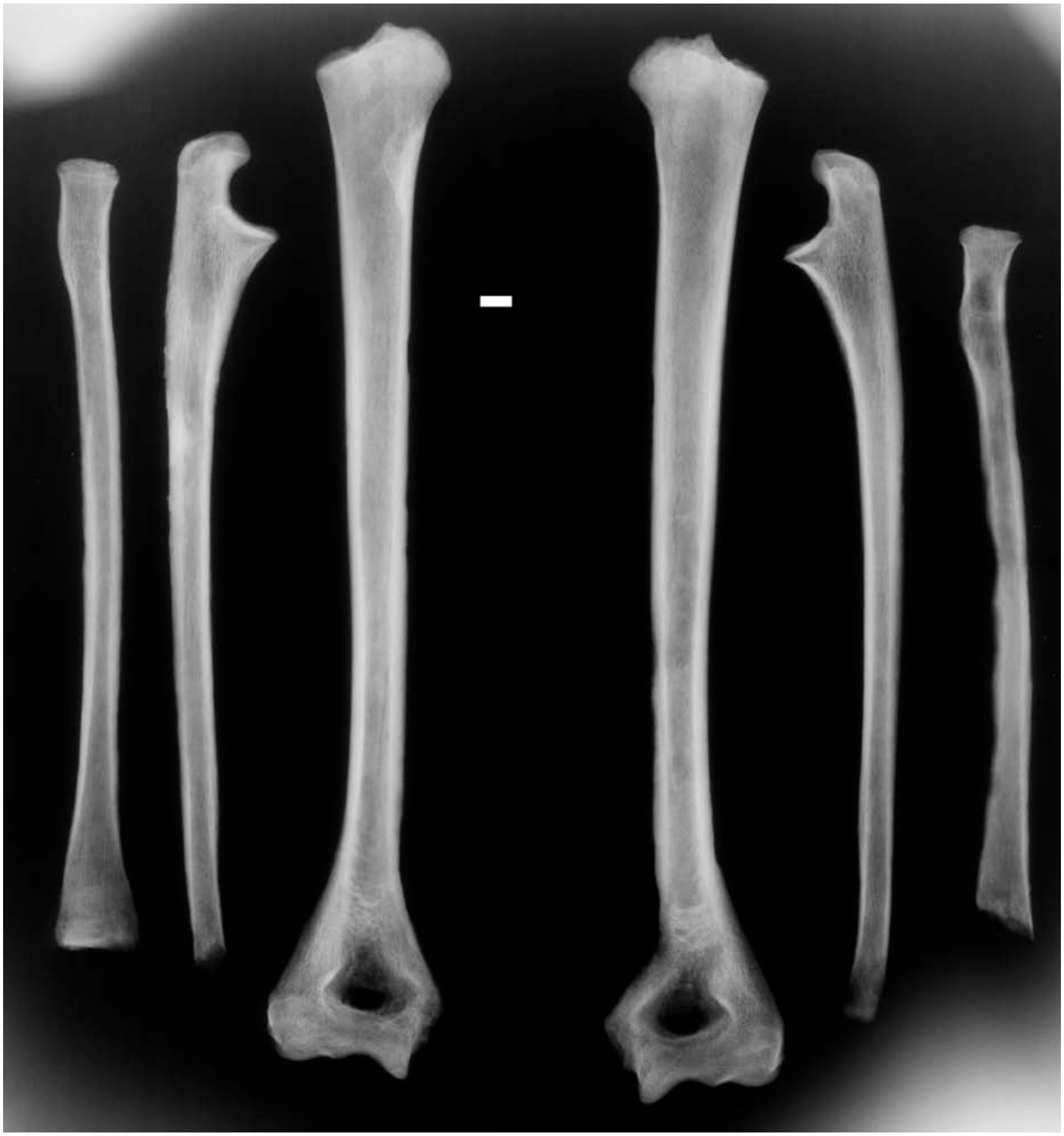
Appendix 1-16. Vault 2, Individual A, right proximal femur; tibia; and fibula.



Appendix 1-17. Vault 2, Individual A, left fibula and tibia, and left proximal femur.

Appendix 1-18. Vault 2, Individual A, left proximal femur; left tibia and fibula.

Appendix 1-19. Vault 2, Individual A, right and left distal femur, left distal tibia; below, right distal tibia.



Appendix 1-20. Vault 2, Individual A, right and left radius, ulna, and humerus.

Appendix 1-21. Vault 2, Individual A, right and left proximal tibia.

Appendix 2. Skeletal Data

All of the following forms are adapted from Burkstra and Ubelaker (1994).

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 1 / Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault, November 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	2	2	Sphenoid	3	3
Parietal	2	2	Zygomatic	3	3
Occipital	2	2	Maxilla	2	2
Temporal	2	2	Palatine	2	2
TMJ	2	2	Mandible	2	2

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	2	2	Os Coxae		
Scapula			Ilium	2	2
Body	2	2	Ischium	3	3
Glenoid f.	2	2	Pubis	3	3
Patella	2	1	Acetabulum	2	2
Sacrum	2	2	Auric. Surface	2	2

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	3	3
C2	3	3
C7	3	3
T10	1	2
T11	1	2
T12	1	2
L1	1	1
L2	1	1
L3	1	1
L4	1	1
L5	1	1

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	0 /	0 /
T1-T9	8 / 8	8 / 8

Sternum: Manubrium 3 Body 2

RIBS (individual)

	L	R
1st	3	3
2nd	3	3
11th	3	3
12th	3	3

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	8 / 0	8 / 0	/

Series/Burial/Skeleton Vault 1, Indiv A
Observer/Date D. Hacker, Oct. 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus	3				
Right Humerus	3				
Left Radius	3				
Right Radius	3				
Left Ulna	3				
Right Ulna	3				
Left Femur	1	1	1	1	1
Right Femur	1	1	1	1	1
Left Tibia	1	1	1	1	1
Right Tibia	1	1	1	1	1
Left Fibula	1	1	1	1	1
Right Fibula	1	1	1	1	1

Left Talus 3
Right Talus 1
Left Calcaneus 1
Right Calcaneus 1

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	0 /	0 /	/
#Metacarpals	1 / 1	2 / 2	/
#Phalanges	1 / 1	3 / 3	/

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	2 / 2	5 / 5	5 / 0
#Metatarsals	0 /	/	/
#Phalanges	0 /	/	/

Comments:

CRANIAL AND POSTCRANIAL MEASUREMENT RECORDING FORM: ADULT REMAINS

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 1 / Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault, November 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Cranial Measurements

1. Maximum Cranial Length: 85.2
2. Maximum Cranial Breadth: 90.3
3. Bizygomatic Diameter: ______
4. Basion-Bregma Height: ______
5. Cranial Base Length: ______
6. Basion-Prosthion Length: ______
7. Maxillo-Alveolar Breadth: 54.5
8. Maxillo-Alveolar Length: 31.2*
9. Biauricular Breadth: ______
10. Upper Facial Height: ______
11. Minimum Frontal Breadth: 45.3
12. Upper Facial Breadth: ______
13. Nasal Height: ______
14. Nasal Breadth: ______
15. Orbital Breadth: ______
16. Orbital Height: ______
17. Biorbital Breadth: ______
18. Interorbital Breadth: ______
19. Frontal Chord: 108.9
20. Parietal Chord: 171.0
21. Occipital Chord: ______
22. Foramen Magnum Length: ______
23. Foramen Magnum Breadth: ______
24. Mastoid Length: ______
25. Chin Height 28.7*
26. Height of the Mandibular Body: 27.9R
27. Breadth of the Mandibular Body: 5.9
28. Bigonial Width: 76.7
29. Bicondylar Breadth: ______
30. Minimum Ramus Breadth: ______
31. Maximum Ramus Breadth: ______
32. Maximum Ramus Height: ______
33. Mandibular Length: ______
34. Mandibular Angle: ______

Series/Burial/Skeleton Vault 1/Individual A

Observer/Date D. Hacker / Oct 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Postcranial Measurements

35. Clavicle: Maximum Length: 138.0
36. Clavicle: Ant.-Post. Diameter at Midshaft: 9.6
37. Clavicle: Sup.-Inf. Diameter at Midshaft: 9.4*
38. Scapula: Height: ______
39. Scapula: Breadth: ______
40. Humerus: Maximum Length: 243*
41. Humerus: Epicondylar Breadth: 47.0R
42. Humerus: Vertical Diameter of Head: ______
43. Humerus: Maximum Diameter at Midshaft: 20.2
44. Humerus: Minimum Diameter at Midshaft: 15.8
45. Radius: Maximum Length: 213.0
46. Radius: Anterior-Posterior Diameter at Midshaft : 9.5
47. Radius: Medial-Lateral Diameter at Midshaft: 9.0
48. Ulna: Maximum Length: 235.0
49. Ulna: Anterior-Posterior Diameter: 11.5
50. Ulna: Medial-Lateral Diameter: 13.0
51. Ulna: Physiological Length: 211.0
52. Ulna: Minimum Circumference: 30.0*
53. Sacrum: Anterior Length: ______
54. Sacrum: Anterior Superior Breadth: 111.0*
55. Sacrum: Max. Transverse Diameter of Base: 39.3
56. Os Coxae: Height: 185.0
57. Os Coxae: Iliac Breadth: 145.0
58. Os Coxae: Pubis Length: ______
59. Os Coxae: Ischium Length: 82.1
60. Femur: Maximum Length: 442.0
61. Femur: Bicondylar Length: 444.0
62. Femur: Epicondylar Breadth: 70.0
63. Femur: Maximum Diameter of the Femur Head: 38.7
64. Femur: Ant.-Post. Subtrochanteric Diameter: 25.2
65. Femur: Medial-Lateral Subtrochanteric Diameter: 30.3
66. Femur: Anterior-Posterior Midshaft Diameter: 28.1
67. Femur: Medial-Lateral Midshaft Diameter: 24.6
68. Femur: Midshaft Circumference: 84.0
69. Tibia: Length: 356.0
70. Tibia: Maximum Proximal Epiphyseal Breadth: 66.5
71. Tibia: Maximum Distal Epiphyseal Breadth: 46.0
72. Tibia: Max. Diameter at the Nutrient Foramen: 29.1
73. Tibia: Med.-Lat. Diameter at Nutrient Foramen: 23.8
74. Tibia: Circumference at the Nutrient Foramen: 85.0
75. Fibula: Maximum Length: 345.0
76. Fibula: Maximum Diameter at Midshaft: 15.8R
77. Calcaneus: Maximum Length: 71.0
78. Calcaneus: Middle Breadth: 36.8

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT, WEAR, AND PATHOLOGY: PERMANENT TEETH

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 1 /

Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault, November 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Occlusal surface wear:** use left teeth, following Smith (1984) for anterior teeth (code 1-8) and Scott (1979) for molars (code 0-10). If marked asymmetry is present, record both sides. Record each molar quadrant separate in the spaces provided (+) and the total for all four quadrants under "Total." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

		Tooth Presence	Development	Wear	Total	Caries			Abscess	Calculus	Affected
Maxillary Right	1 M³	5	5								
	2 M²	5									
	3 M¹	5									
	4 P²	2	14			0			0	0	
	5 P¹	2	14			0			0	1	
	6 C	2	14			0			0	1	
	7 I²	2	14			0			0	1	
	8 I¹	5									
Maxillary Left	9 I¹	2	14	4	4	0			0	1	buc/ling
	10 I²	2	14	1	1	0			0	0	
	11 C	2	14	2	2	0			0	0	
	12 P¹	2	14	2	2	0			0	0	
	13 P²	2	14	1	1	0			0	0	
	14 M¹	2	14	5:5:2:2	14	0			0	0	
	15 M²	5									
	16 M³	5									

Series/Burial/Skeleton Vault 1, Indiv. A

Observer/Date D. Hacker/Oct. 2014

	Tooth	Tooth Presence	Development	Wear	/Total	Caries			Abscess	Calculus	/Affected
Mandibular Left	17 M_3	5							0		
	18 M_2	2	14	3:3:3	7	0			0	0	
	19 M_1	2	14	3:1:4:4	12	0			0	0	
	20 P_2	5							0		
	21 P_1	2	14	1	1	0			0	1	
	22 C	2	14	2	2	0			0	0	
	23 I_2	2	14	4	4	0			0	0	
	24 I_1	5							0		
Mandibular Right	25 I_1	5							0		
	26 I_2	2	14	4	4	0			0	1	lingual
	27 C	2	14	2	2	0			0	1	buccal
	28 P_1	5							0		
	29 P_2	2	14	1	1	0			0	1	lingual
	30 M_1	2	14	5:2:5:2	14	0			0	0	
	31 M_2	1	14	1:1:1:2	5	1			0	0	
	32 M_3	2	14	2:2:1	5	0			0	0	

Estimated dental age (juveniles only)____________

Supernumerary Teeth:	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)
	___/___	___	___/___	___	___/___	___
	___/___	___	___/___	___	___/___	___

Comments:

DENTAL MEASUREMENTS AND MORPHOLOGY RECORDING FORM

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 1 / Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault 1, Nov 2014

Dental Measurements

Record left side of arcade only; substitute antimere when left not observable.

Maxilla

Tooth	I^1	I^2	C	PM^1	PM^2	M^1	M^2	M^3
Mesiodistal diameter	7.4	6.4	7.6	6.6	5.9	9.3		
Buccolingual diameter	6.6	6.5	7.8	8.6	8.4	11.3		
Crown height	9.7	10.3	10.7	8.1	6.7	7.9		

Mandible

Tooth	M_3	M_2	M_1	PM_2	PM_1	C	I_2	I_1
Mesiodistal diameter	9.6	9.3	9.8	6.5	6.3	6.1	5.4	
Buccolingual diameter	9.2	9.3	9.7	6.2	7.0	7.1	6.1	
Crown height	6.6	6.5	6.5	6.9	7.6	9.8	8.5	

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date Oct. 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	2	2	Sphenoid		
Parietal	2	2	Zygomatic		
Occipital			Maxilla	1	1
Temporal	2	2	Palatine	2	2
TMJ	2	1	Mandible	1	1

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	1		Os Coxae		
Scapula			Ilium	1	1
Body	1	1	Ischium	2	2
Glenoid f.			Pubis		
Patella	1		Acetabulum	2	2
Sacrum	1	1	Auric. Surface	1	2

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	1	1
C2	1	1
C7	1	1
T10	1	1
T11	1	1
T12	1	1
L1	1	1
L2	1	1
L3	1	1
L4	1	1
L5	1	1

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	4 / 4	4 / 4
T1-T9	7 / 7	7 / 7

Sternum: Manubrium 1 Body 1

RIBS (individual)

	L	R
1st	2	2
2nd	2	
11th		
12th		

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	5 /	2 /	/

Series/Burial/Skeleton Vault 2, Indiv A

Observer/Date D. Hacker Oct. 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus	1	1	1	1	1
Right Humerus	1	1	1	1	1
Left Radius	1	1	1	1	1
Right Radius	1	1	1	1	2
Left Ulna	1	1	1	1	2
Right Ulna	1	1	1	1	2
Left Femur	1	1	1	1	1
Right Femur	1	1	1	1	1
Left Tibia	1	1	1	1	1
Right Tibia	1	1	1	1	1
Left Fibula	2	1	1	1	1
Right Fibula	2	1	1	1	1

Left Talus 1

Right Talus 1

Left Calcaneus 1

Right Calcaneus 1

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	4 / 1	4 / 1	/
#Metacarpals	5 / 4	5 / 3	/
#Phalanges	13 / 8	10 / 3	/

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	6 / 1	5 / 5	/
#Metatarsals	5 / 2	5 / 3	/
#Phalanges	5 / 5	5 / 5	/

Comments:

CRANIAL AND POSTCRANIAL MEASUREMENT RECORDING FORM: ADULT REMAINS

Site Name/Number 31BW787**2 / ______

Observer D. Hacker

Feature/Burial Number Vault 2 / ______

Date Oct. 2014

Burial/Skeleton Number Individual A / ______

Present Location of Collection Reinterred in Vault 2, Nov 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Cranial Measurements

1. Maximum Cranial Length: ______
2. Maximum Cranial Breadth: ______
3. Bizygomatic Diameter: ______
4. Basion-Bregma Height: ______
5. Cranial Base Length: ______
6. Basion-Prosthion Length: ______
7. Maxillo-Alveolar Breadth: 57.5
8. Maxillo-Alveolar Length: 48.5
9. Biauricular Breadth: ______
10. Upper Facial Height: 90.2
11. Minimum Frontal Breadth: 97.2
12. Upper Facial Breadth: 102.8
13. Nasal Height: 67.1
14. Nasal Breadth: 22.6
15. Orbital Breadth: 38.4
16. Orbital Height: 44.2*
17. Biorbital Breadth: 91.8
18. Interorbital Breadth: 20.4
19. Frontal Chord: ______
20. Parietal Chord: ______
21. Occipital Chord: ______
22. Foramen Magnum Length: ______
23. Foramen Magnum Breadth: ______
24. Mastoid Length: 31.1
25. Chin Height 33.6
26. Height of the Mandibular Body: 30.6
27. Breadth of the Mandibular Body: 10.8
28. Bigonial Width: 94.7
29. Bicondylar Breadth: 110.4
30. Minimum Ramus Breadth: 29.6
31. Maximum Ramus Breadth: 36.9
32. Maximum Ramus Height: 54.3*
33. Mandibular Length: 66.6
34. Mandibular Angle: 122

Series/Burial/Skeleton Vault 2, Individual A
Observer/Date D. Hacker / Oct 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Postcranial Measurements

35. Clavicle: Maximum Length: 137.0
36. Clavicle: Ant.-Post. Diameter at Midshaft: 8.3
37. Clavicle: Sup.-Inf. Diameter at Midshaft: 10.8
38. Scapula: Height: 98.4
39. Scapula: Breadth: 141.2
40. Humerus: Maximum Length: 324.0
41. Humerus: Epicondylar Breadth: 52.0
42. Humerus: Vertical Diameter of Head: 40.8
43. Humerus: Maximum Diameter at Midshaft: 19.4
44. Humerus: Minimum Diameter at Midshaft: 16.4
45. Radius: Maximum Length: 233R
46. Radius: Anterior-Posterior Diameter at Midshaft : 11.2R
47. Radius: Medial-Lateral Diameter at Midshaft: 12.7R
48. Ulna: Maximum Length: 252.0
49. Ulna: Anterior-Posterior Diameter: 11.6
50. Ulna: Medial-Lateral Diameter: 13.7
51. Ulna: Physiological Length: 223.5
52. Ulna: Minimum Circumference: 35.0
53. Sacrum: Anterior Length: 108.5
54. Sacrum: Anterior Superior Breadth: 35.5
55. Sacrum: Max. Transverse Diameter of Base: 113.0
56. Os Coxae: Height: 258.7
57. Os Coxae: Iliac Breadth: 200*
58. Os Coxae: Pubis Length: ______
59. Os Coxae: Ischium Length: 143.1
60. Femur: Maximum Length: 476.0
61. Femur: Bicondylar Length: 475.0
62. Femur: Epicondylar Breadth: 76.0
63. Femur: Maximum Diameter of the Femur Head: 45.0
64. Femur: Ant.-Post. Subtrochanteric Diameter: 24.8
65. Femur: Medial-Lateral Subtrochanteric Diameter: 26.6
66. Femur: Anterior-Posterior Midshaft Diameter: 24.5
67. Femur: Medial-Lateral Midshaft Diameter: 26.2
68. Femur: Midshaft Circumference: 81.0
69. Tibia: Length: 378.0
70. Tibia: Maximum Proximal Epiphyseal Breadth: 71.0
71. Tibia: Maximum Distal Epiphyseal Breadth: 46.0
72. Tibia: Max. Diameter at the Nutrient Foramen: 29.6
73. Tibia: Med.-Lat. Diameter at Nutrient Foramen: 24.2
74. Tibia: Circumference at the Nutrient Foramen: 89.0
75. Fibula: Maximum Length: 356.0
76. Fibula: Maximum Diameter at Midshaft: 14.4
77. Calcaneus: Maximum Length: 75.9
78. Calcaneus: Middle Breadth: 43.0

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT, WEAR, AND PATHOLOGY: PERMANENT TEETH

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date Oct. 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Occlusal surface wear:** use left teeth, following Smith (1984) for anterior teeth (code 1-8) and Scott (1979) for molars (code 0-10). If marked asymmetry is present, record both sides. Record each molar quadrant separate in the spaces provided (+) and the total for all four quadrants under "Total." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

		Tooth Presence	Development	Wear	/Total	Caries			Abscess	Calculus/Affected
Maxillary Right	1 M³	8	9							
	2 M²	2	14	2/1:2/1	6	3	3			
	3 M¹	2	14	4/4:4/4	16	3	3	2		1 / lingual
	4 P²	2	14	2	2	2	2			
	5 P¹	2	14	1	1	2				
	6 C	2	14	4	4					
	7 I²	2	14	2	2					
	8 I¹	2	14	4	4					
Maxillary Left	9 I¹	2	14	4	4					
	10 I²	2	14	2	2					
	11 C	2	14	2	2					
	12 P¹	2	14	2	2	2				
	13 P²	2	14	1	1	2				
	14 M¹	2	14	4/3:1/1	9	3				1 buc/ling
	15 M²	2	14	4/1:1/1	7	3				1 buc/ling
	16 M³	9	9			3				

Series/Burial/Skeleton Vault 2, Indiv. A

Observer/Date D. Hacker, Oct. 2014

		Tooth Presence	Development	Wear /Total		Caries			Abscess	Calculus/Affected	
Mandibular Left	17 M_3	8	9								
	18 M_2	2	14	4/1:4/3	12	3					
	19 M_1	2	14	1/3:4/4	12	1					
	20 P_2	2	14	1	1						
	21 P_1	2	14	1	1						
	22 C	2	14	1	1						
	23 I_2	2	14	3	3						
	24 I_1	2	14	4	4						
Mandibular Right	25 I_1	2	14	4	4						
	26 I_2	2	14	3	3						
	27 C	2	14	3	3						
	28 P_1	2	14	1	1						
	29 P_2	2	14	1	1						
	30 M_1	2	14	4/4:3/1	12	1					
	31 M_2	2	14	3/2:3/1	9						
	32 M_3	8	9								

Estimated dental age (juveniles only) 15YR +/- 36 mo

Supernumerary Teeth:	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)
	/		/		/	
	/		/		/	

Comments:

DENTAL MEASUREMENTS AND MORPHOLOGY RECORDING FORM

Site Name/Number 31BW787**2 /
Observer D. Hacker

Feature/Burial Number Vault 2 /
Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Dental Measurements

Record left side of arcade only; substitute antimere when left not observable.

Maxilla

Tooth	I^1	I^2	C	PM^1	PM^2	M^1	M^2	M^3
Mesiodistal diameter	8.3	6.4	7.1	6.8	6.6	10.9	9.8	9.1
Buccolingual diameter	7.2	6.4	8.7	8.7	8.4	11.0	11.0	10.8
Crown height	10.8	10.2	11.1	8.2	7.6	7.5	7.5	6.9

Mandible

Tooth	M_3	M_2	M_1	PM_2	PM_1	C	I_2	I_1
Mesiodistal diameter		10.0	10.2	6.3	6.1	6.0	5.7	5.0
Buccolingual diameter		10.0	10.2	7.7	7.1	7.6	6.1	6.0
Crown height		7.2	7.3	8.2	8.2	11.3	9.3	8.8

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date Oct 2014

Burial/Skeleton Number Individual W /

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal			Sphenoid		
Parietal			Zygomatic		
Occipital	2	2	Maxilla		
Temporal			Palatine		
TMJ			Mandible		

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	1	1	Os Coxae		
Scapula			Ilium	1	1
Body	2		Ischium	1	1
Glenoid f.			Pubis	1	
Patella			Acetabulum		
Sacrum			Auric. Surface	1	1

VERTEBRAE (individual)

	Centrum	Neural Arch
C1		
C2		
C7		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	/	/
T1-T9	/	/

Sternum: Manubrium ____ Body ____

RIBS (individual)

	L	R
1st	1	1
2nd		
11th		
12th		

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	/	/	/

Series/Burial/Skeleton Vault 2, Indiv W

Observer/Date D. Hacker, Oct 2014

LONG BONES

	Proximal Epiphysis	Diaphysis: Proximal Third	Diaphysis: Middle Third	Diaphysis: Distal Third	Distal Epiphysis
Left Humerus			2		
Right Humerus		1	1	1	
Left Radius		1	1	1	
Right Radius					
Left Ulna		1	1	1	
Right Ulna		1	1	1	
Left Femur		1	1	2	
Right Femur		1	1	2	
Left Tibia		1	1	1	
Right Tibia		1	1	2	
Left Fibula			1		
Right Fibula					

Left Talus____

Right Talus____

Left Calcaneus____

Right Calcaneus____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	___/___	___/___	___/___
#Metacarpals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	___/___	___/___	___/___
#Metatarsals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

Comments:

IMMATURE MEASUREMENTS RECORDING FORM

Site Name/Number 31BW787**2 / ______ Observer D. Hacker

Feature/Burial Number Vault 2 / ______ Date Oct 2014

Burial/Skeleton Number Individual W / ______

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL MEASUREMENTS

	L	M	R
1. Lesser Wing of the Sphenoid			
(a) Length:	______		______
(b) Width:	______		______
2. Greater Wing of the Sphenoid			
(a) Length	______		______
(b) Width:	______		______
3. Body of the Sphenoid			
(a) Length:		______	
(b) Width:		______	
4. Petrous and Mastoid Portions of the Temporal			
(a) Length:	______		______
(b) Width:	______		______
5. Basilar Part of the Occipital			
(a) Length:		______	
(b) Width:		______	
6. Zygomatic			
(a) Length:	______		______
(b) Width:	______		______
7. Maxilla			
(a) Length:	______		______
(b) Height:	______		______
(c) Width:	______		______
8. Mandible			
(a) Length of the Body:	______		______
(b) Width of the Arc:	______		______
(c) Full Length of Half Mandible:		______	

Series/Burial/Skeleton Vault 2, Indiv W
Observer/Date Hacker / Oct 2014

POSTCRANIAL MEASUREMENTS

	L	R
9. Clavicle		
(a) Length:	57.3*	55.7*
(b) Diameter:	5.3	
10. Scapula		
(a) Length (height):	6.0	
(b) Width:		
(c) Length of the Spine:		
11. Ilium		
(a) Length:	51.2	53.3
(b) Width:	52.6	53.0
12. Ischium		
(a) Length:	31.8	31.5
(b) Width:	21.2	21.5
13. Pubis		
(a) Length:	22.9*	
14. Humerus		
(a) Length:	65.8*	110.9
(b) Width:		20.1
(c) Diameter:	7.8*	10.6

	L	R
15. Ulna		
(a) Length:	90.1*	86.6*
(b) Diameter:	5.8*	6.7*
16. Radius		
(a) Length:		73.8*
(b) Diameter:		5.7
17. Femur		
(a) Length:	136.6*	128.9*
(b) Width:	21.4*	
(c) Diameter:	10.5	9.9
18. Tibia		
(a) Length:	113.8	78.2*
(b) Diameter:	9.2	8.0
19. Fibula		
(a) Length:	95.0*	
(b) Diameter:	5.2	

Comments:

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT AND PATHOLOGY: DECIDUOUS TEETH

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 2 /

Date October 2014

Burial/Skeleton Number Individual W /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Presence	Development	Caries	Abscess	Calculus/Affected
Maxillary Right	51 m²					
	52 m¹					
	53 c					
	54 i²					
	55 i¹					
Maxillary Left	56 i¹					
	57 i²					
	58 c					
	59 m¹					
	60 m²					
Mandibular Left	61 m²					
	62 m¹					
	63 c					
	64 i²					
	65 i¹					
Mandibular Right	66 i¹					
	67 i²					
	68 c					
	69 m¹					
	70 m²					

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / ____ Observer D. Hacker

Feature/Burial Number Vault 2 / ____ Date Oct 2014

Burial/Skeleton Number Individual X / ____

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	___	___	Sphenoid	___	___
Parietal	___	___	Zygomatic	___	___
Occipital	___	___	Maxilla	2	2
Temporal	___	___	Palatine	___	___
TMJ	___	___	Mandible	2	2

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	___	2	Os Coxae		
Scapula			Ilium	___	1
Body	___	3	Ischium	1	1
Glenoid f.	___	___	Pubis	___	1
Patella	___	___	Acetabulum	___	___
Sacrum	___	___	Auric. Surface	___	1

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	___	___
C2	___	___
C7	___	___
T10	___	___
T11	___	___
T12	___	___
L1	___	___
L2	___	___
L3	___	___
L4	___	___
L5	___	___

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	___/___	___/___
T1-T9	___/___	___/___

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st	___	1
2nd	___	___
11th	___	___
12th	___	___

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	___/___	___/___	___/___

Series/Burial/Skeleton Vault 2, Indiv X

Observer/Date D. Hacker / Oct 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus		1	1	1	
Right Humerus		1	1	1	
Left Radius		1	1	1	
Right Radius		1	1	1	
Left Ulna		1	1	1	
Right Ulna		1	1	1	
Left Femur		1	1	1	
Right Femur		1	1	1	
Left Tibia		1	1	1	
Right Tibia		1	1		
Left Fibula					
Right Fibula			1		

Left Talus_____

Right Talus_____

Left Calcaneus_____

Right Calcaneus_____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	/	/	/
#Metacarpals	/	/	/
#Phalanges	/	/	/

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	/	/	/
#Metatarsals	/	/	/
#Phalanges	/	/	/

Comments:

IMMATURE MEASUREMENTS RECORDING FORM

Site Name/Number 31BW787**2 / ______ Observer D. Hacker

Feature/Burial Number Vault 2 / ______ Date Oct 2014

Burial/Skeleton Number Individual X / ______

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL MEASUREMENTS

	L	M	R
1. Lesser Wing of the Sphenoid			
(a) Length:	______		______
(b) Width:	______		______
2. Greater Wing of the Sphenoid			
(a) Length	______		______
(b) Width:	______		______
3. Body of the Sphenoid			
(a) Length:		______	
(b) Width:		______	
4. Petrous and Mastoid Portions of the Temporal			
(a) Length:	______		______
(b) Width:	______		______
5. Basilar Part of the Occipital			
(a) Length:		______	
(b) Width:		______	
6. Zygomatic			
(a) Length:	______		______
(b) Width:	______		______
7. Maxilla			
(a) Length:	______		______
(b) Height:	______		______
(c) Width:	______		______
8. Mandible			
(a) Length of the Body:	______		______
(b) Width of the Arc:	______		______
(c) Full Length of Half Mandible:		______	

Series/Burial/Skeleton Vault 2, Indiv X
Observer/Date D. Hacker / Oct 2014

POSTCRANIAL MEASUREMENTS

	L	R
9. Clavicle		
(a) Length:		
(b) Diameter:		
10. Scapula		
(a) Length (height):		
(b) Width:		
(c) Length of the Spine:		
11. Ilium		
(a) Length:		52.2*
(b) Width:		49.2*
12. Ischium		
(a) Length:	33.8	33.0*
(b) Width:	21.1*	20.1*
13. Pubis		
(a) Length:		25.5*
14. Humerus		
(a) Length:	117.1	118.3
(b) Width:	20.0	19.9
(c) Diameter:	10.8	9.8

	L	R
15. Ulna		
(a) Length:		90.1*
(b) Diameter:	6.7	6.7
16. Radius		
(a) Length:	85.7	86.4
(b) Diameter:	6.1	
17. Femur		
(a) Length:	139.5	139.5
(b) Width:	30.0*	29.2*
(c) Diameter:	10.5	11.0
18. Tibia		
(a) Length:	111.9*	105.7*
(b) Diameter:	8.8	9.8
19. Fibula		
(a) Length:		
(b) Diameter:		5.4

Comments:

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT AND PATHOLOGY: DECIDUOUS TEETH

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 2 /

Date October 2014

Burial/Skeleton Number Individual X /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Presence	Development	Caries			Abscess	Calculus/Affected	
Maxillary Right	51 m²	1	9						
	52 m¹	2	10						
	53 c	2	9						
	54 i²	5		3					
	55 i¹	2		3					
Maxillary Left	56 i¹	2							
	57 i²	2							
	58 c	2	9						
	59 m¹	5							
	60 m²	1							
Mandibular Left	61 m²	1	10						
	62 m¹	2							
	63 c	5							
	64 i²	5							
	65 i¹	5							
Mandibular Right	66 i¹	2							
	67 i²	5							
	68 c	2	10						
	69 m¹	5							
	70 m²	1	10						

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / ____________

Observer D. Hacker

Feature/Burial Number Vault 2 / ____________

Date Oct 2014

Burial/Skeleton Number Individual Y / ____________

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	___	___	Sphenoid	___	___
Parietal	___	___	Zygomatic	___	___
Occipital	___	___	Maxilla	2	2
Temporal	___	___	Palatine	___	___
TMJ	___	___	Mandible	2	1

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	1	1	Os Coxae		
Scapula			Ilium	1	1
Body	___	2	Ischium	1	1
Glenoid f.	___	___	Pubis	___	1
Patella	___	___	Acetabulum	___	___
Sacrum	___	___	Auric. Surface	1	1

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	___	___
C2	___	___
C7	___	___
T10	___	___
T11	___	___
T12	___	___
L1	___	___
L2	___	___
L3	___	___
L4	___	___
L5	___	___

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	___/___	___/___
T1-T9	___/___	___/___

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st	___	___
2nd	___	___
11th	___	___
12th	___	___

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	___/___	___/___	___/___

Series/Burial/Skeleton Vault 2, Indiv Y
Observer/Date D. Hacker, Oct 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus		1	1	1	
Right Humerus		1	1	1	
Left Radius		1	3		
Right Radius		1	1	1	
Left Ulna					
Right Ulna		1	1	1	
Left Femur		1	1	1	
Right Femur		1	1	1	
Left Tibia					
Right Tibia		1	1	1	
Left Fibula			1	1	
Right Fibula			1		

Left Talus____
Right Talus____
Left Calcaneus____
Right Calcaneus____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	___/___	___/___	___/___
#Metacarpals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	___/___	___/___	___/___
#Metatarsals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

Comments:

IMMATURE MEASUREMENTS RECORDING FORM

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date Oct 2014

Burial/Skeleton Number Individual Y /

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL MEASUREMENTS

	L	M	R
1. Lesser Wing of the Sphenoid			
(a) Length:	____		____
(b) Width:	____		____
2. Greater Wing of the Sphenoid			
(a) Length	____		____
(b) Width:	____		____
3. Body of the Sphenoid			
(a) Length:		____	
(b) Width:		____	
4. Petrous and Mastoid Portions of the Temporal			
(a) Length:	____		____
(b) Width:	____		____
5. Basilar Part of the Occipital			
(a) Length:		____	
(b) Width:		____	
6. Zygomatic			
(a) Length:	____		____
(b) Width:	____		____
7. Maxilla			
(a) Length:	____		____
(b) Height:	____		____
(c) Width:	____		____
8. Mandible			
(a) Length of the Body:	____		____
(b) Width of the Arc:	____		____
(c) Full Length of Half Mandible:		____	

Series/Burial/Skeleton Vault 2, Indiv Y
Observer/Date D. Hacker / Oct 2014

POSTCRANIAL MEASUREMENTS

	L	R
9. Clavicle		
(a) Length:	63.8*	63.4*
(b) Diameter:	4.7	5.1
10. Scapula		
(a) Length (height):		
(b) Width:		
(c) Length of the Spine:		
11. Ilium		
(a) Length:	56.3*	60.0*
(b) Width:	52.0*	53.6*
12. Ischium		
(a) Length:	34.1	33.0*
(b) Width:	21.1*	20.1*
13. Pubis		
(a) Length:		25.5*
14. Humerus		
(a) Length:	117.1	118.3
(b) Width:	20.0	19.9
(c) Diameter:	10.8	9.8

	L	R
15. Ulna		
(a) Length:		90.1*
(b) Diameter:	6.7	6.7
16. Radius		
(a) Length:	85.7	86.4
(b) Diameter:	6.1	
17. Femur		
(a) Length:	139.5	139.5
(b) Width:		
(c) Diameter:	10.5	11.0
18. Tibia		
(a) Length:	111.9*	
(b) Diameter:	8.8	9.8
19. Fibula		
(a) Length:		
(b) Diameter:		5.4

Comments:

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT AND PATHOLOGY: DECIDUOUS TEETH

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date October 2014

Burial/Skeleton Number Individual Y /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Presence	Development	Caries			Abscess	Calculus/Affected	
Maxillary Right	51 m²	2	10						
	52 m¹	5							
	53 c	5							
	54 i²	5							
	55 i¹	2		3					
Maxillary Left	56 i¹	2							
	57 i²	5							
	58 c	2	9						
	59 m¹	2	12						
	60 m²	2	10						
Mandibular Left	61 m²	2	9						
	62 m¹	2	11						
	63 c	2	10						
	64 i²	5							
	65 i¹	5							
Mandibular Right	66 i¹	5							
	67 i²	5							
	68 c	2	9						
	69 m¹	2	11						
	70 m²	2	9						

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 2 /

Date Oct 2014

Burial/Skeleton Number Individual Z /

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal			Sphenoid		
Parietal			Zygomatic		
Occipital			Maxilla		
Temporal			Palatine		
TMJ			Mandible	3	3

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	1	1	Os Coxae		
Scapula			Ilium	1	1
Body	1	1	Ischium	1	1
Glenoid f.			Pubis	1	1
Patella			Acetabulum	1	1
Sacrum			Auric. Surface	1	1

VERTEBRAE (individual)

	Centrum	Neural Arch
C1		
C2		
C7		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	/	/
T1-T9	/	/

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st		
2nd		
11th		
12th		

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	/	/	/

Series/Burial/Skeleton Vault 2, Indiv Z

Observer/Date D. Hacker / Oct 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus	___	___	___	___	___
Right Humerus	___	1	1	1	___
Left Radius	___	1	1	1	___
Right Radius	___	___	___	___	___
Left Ulna	___	1	1	1	___
Right Ulna	___	___	___	___	___
Left Femur	___	1	1	1	___
Right Femur	___	1	1	1	___
Left Tibia	___	1	1	1	___
Right Tibia	___	1	1	1	___
Left Fibula	___	___	___	___	___
Right Fibula	___	3	1	___	___

Left Talus_____

Right Talus_____

Left Calcaneus_____

Right Calcaneus_____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	___/___	___/___	___/___
#Metacarpals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	___/___	___/___	___/___
#Metatarsals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

Comments:___________________________________

IMMATURE MEASUREMENTS RECORDING FORM

Site Name/Number 31BW787**2 / ________ Observer D. Hacker

Feature/Burial Number Vault 2 / ________ Date Oct 2014

Burial/Skeleton Number Individual Z / ________

Present Location of Collection Reinterred in Vault 2, Nov 2014

CRANIAL MEASUREMENTS

	L	M	R
1. Lesser Wing of the Sphenoid			
(a) Length:	____		____
(b) Width:	____		____
2. Greater Wing of the Sphenoid			
(a) Length	____		____
(b) Width:	____		____
3. Body of the Sphenoid			
(a) Length:		____	
(b) Width:		____	
4. Petrous and Mastoid Portions of the Temporal			
(a) Length:	____		____
(b) Width:	____		____
5. Basilar Part of the Occipital			
(a) Length:		____	
(b) Width:		____	
6. Zygomatic			
(a) Length:	____		____
(b) Width:	____		____
7. Maxilla			
(a) Length:	____		____
(b) Height:	____		____
(c) Width:	____		____
8. Mandible			
(a) Length of the Body:	____		____
(b) Width of the Arc:	____		____
(c) Full Length of Half Mandible:		____	

Series/Burial/Skeleton Vault 2, Indiv Z
Observer/Date D. Hacker / Oct 2014

POSTCRANIAL MEASUREMENTS

	L	R
9. Clavicle		
(a) Length:	59.8*	60.5*
(b) Diameter:	4.9	5.3
10. Scapula		
(a) Length (height):	60.8	
(b) Width:		
(c) Length of the Spine:		
11. Ilium		
(a) Length:	53.2*	59.0*
(b) Width:	54.2*	54.3*
12. Ischium		
(a) Length:	36.58	36.5*
(b) Width:	23.3*	23.3*
13. Pubis		
(a) Length:	29.3*	29.2*
14. Humerus		
(a) Length:		
(b) Width:		23.5*
(c) Diameter:		12.5

	L	R
15. Ulna		
(a) Length:	94.7	
(b) Diameter:	6.9	
16. Radius		
(a) Length:	89.0	
(b) Diameter:	6.8	
17. Femur		
(a) Length:	138.5*	139.0*
(b) Width:	30.8*	31.4*
(c) Diameter:	11.5	11.8
18. Tibia		
(a) Length:		111.4*
(b) Diameter:	8.5	8.8
19. Fibula		
(a) Length:		78.2*
(b) Diameter:		6.12

Comments:

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT AND PATHOLOGY: DECIDUOUS TEETH

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 2 / Date October 2014

Burial/Skeleton Number Individual Z /

Present Location of Collection Reinterred in Vault 2, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Presence	Development	Caries			Abscess	Calculus/Affected	
Maxillary Right	51 m^2								
	52 m^1								
	53 c								
	54 i^2								
	55 i^1								
Maxillary Left	56 i^1								
	57 i^2								
	58 c								
	59 m^1								
	60 m^2								
Mandibular Left	61 m^2	1	6						
	62 m^1	2	12	3					
	63 c	2	10						
	64 i^2	2	13						
	65 i^1	5							
Mandibular Right	66 i^1	2	13						
	67 i^2	2	13	1	1				
	68 c	5							
	69 m^1	5							
	70 m^2	1	6						

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 3 / Date Oct. 2014

Burial/Skeleton Number Individual B /

Present Location of Collection Reinterred in Vault 3, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	2	2	Sphenoid		
Parietal	2	2	Zygomatic		
Occipital	2	2	Maxilla		
Temporal	2		Palatine		
TMJ			Mandible		

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	2		Os Coxae		
Scapula			Ilium	2	
Body			Ischium		
Glenoid f.			Pubis		
Patella	1	1	Acetabulum		
Sacrum	2	2	Auric. Surface		

VERTEBRAE (individual)

	Centrum	Neural Arch
C1		
C2		
C7		
T10		
T11		
T12		
L1		
L2	2	2
L3	2	2
L4		
L5		

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	/	/
T1-T9	/	/

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st		
2nd		
11th		
12th		

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	/	/	4 /

Series/Burial/Skeleton Vault 3, Indiv B
Observer/Date D. Hacker, Oct. 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus	2	2	2	2	2
Right Humerus	2	2	2	2	2
Left Radius	2	2	2	2	2
Right Radius	2	2	2	2	2
Left Ulna	2	2	2	2	2
Right Ulna	2	2	2	2	2
Left Femur	2	2	2	2	2
Right Femur	2	2	2	2	2
Left Tibia	2	2	2	2	2
Right Tibia	2	2	2	2	2
Left Fibula	2	2	2	2	2
Right Fibula	2	2	2	2	2

Left Talus 2
Right Talus 1
Left Calcaneus 2
Right Calcaneus 1

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	2 / 2	1 / 1	/
#Metacarpals	4 / 3	/	/
#Phalanges	5 / 5	7 / 6	/

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	3 / 3	6 / 6	/
#Metatarsals	5 / 2	5 / 1	/
#Phalanges	2 / 2	1 / 1	/

Comments:

CRANIAL AND POSTCRANIAL MEASUREMENT RECORDING FORM: ADULT REMAINS

Site Name/Number 31BW787**2 / ______ Observer D. Hacker

Feature/Burial Number Vault 3 / ______ Date Oct. 2014

Burial/Skeleton Number Individual B / ______

Present Location of Collection Reinterred in Vault 3, Nov 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Cranial Measurements

1. Maximum Cranial Length: ______
2. Maximum Cranial Breadth: 147.2
3. Bizygomatic Diameter: ______
4. Basion-Bregma Height: ______
5. Cranial Base Length: ______
6. Basion-Prosthion Length: ______
7. Maxillo-Alveolar Breadth: ______
8. Maxillo-Alveolar Length: ______
9. Biauricular Breadth: ______
10. Upper Facial Height: ______
11. Minimum Frontal Breadth: 103.6*
12. Upper Facial Breadth: ______
13. Nasal Height: ______
14. Nasal Breadth: ______
15. Orbital Breadth: ______
16. Orbital Height: ______
17. Biorbital Breadth: ______
18. Interorbital Breadth: ______
19. Frontal Chord: ______
20. Parietal Chord: ______
21. Occipital Chord: ______
22. Foramen Magnum Length: ______
23. Foramen Magnum Breadth: ______
24. Mastoid Length: ______
25. Chin Height 24.4*
26. Height of the Mandibular Body: ______
27. Breadth of the Mandibular Body: ______
28. Bigonial Width: ______
29. Bicondylar Breadth: ______
30. Minimum Ramus Breadth: ______
31. Maximum Ramus Breadth: ______
32. Maximum Ramus Height: ______
33. Mandibular Length: ______
34. Mandibular Angle: ______

Series/Burial/Skeleton Vault 3, Individual I

Observer/Date D. Hacker, Oct. 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Postcranial Measurements

35. Clavicle: Maximum Length: 133.0
36. Clavicle: Ant.-Post. Diameter at Midshaft: 10.8R
37. Clavicle: Sup.-Inf. Diameter at Midshaft: 8.1R
38. Scapula: Height: ______
39. Scapula: Breadth: ______
40. Humerus: Maximum Length: 265.0
41. Humerus: Epicondylar Breadth: 46.0
42. Humerus: Vertical Diameter of Head: ______
43. Humerus: Maximum Diameter at Midshaft: 20.7R
44. Humerus: Minimum Diameter at Midshaft: 15.5
45. Radius: Maximum Length: 173*
46. Radius: Anterior-Posterior Diameter at Midshaft: 10.8*
47. Radius: Medial-Lateral Diameter at Midshaft: 13.4*
48. Ulna: Maximum Length: 201R
49. Ulna: Anterior-Posterior Diameter: 13.6R
50. Ulna: Medial-Lateral Diameter: 10.2R
51. Ulna: Physiological Length: ______
52. Ulna: Minimum Circumference: ______
53. Sacrum: Anterior Length: ______
54. Sacrum: Anterior Superior Breadth: ______
55. Sacrum: Max. Transverse Diameter of Base: ______
56. Os Coxae: Height: ______
57. Os Coxae: Iliac Breadth: ______
58. Os Coxae: Pubis Length: ______
59. Os Coxae: Ischium Length: ______
60. Femur: Maximum Length: 475.5
61. Femur: Bicondylar Length: 478.0
62. Femur: Epicondylar Breadth: 70.0*
63. Femur: Maximum Diameter of the Femur Head: 42.2*
64. Femur: Ant.-Post. Subtrochanteric Diameter: 26.2
65. Femur: Medial-Lateral Subtrochanteric Diameter: 28.3
66. Femur: Anterior-Posterior Midshaft Diameter: 27.2
67. Femur: Medial-Lateral Midshaft Diameter: 26.3
68. Femur: Midshaft Circumference: 8.5
69. Tibia: Length: 370R*
70. Tibia: Maximum Proximal Epiphyseal Breadth: 70.0*
71. Tibia: Maximum Distal Epiphyseal Breadth: 52.0
72. Tibia: Max. Diameter at the Nutrient Foramen: 31.7
73. Tibia: Med.-Lat. Diameter at Nutrient Foramen: 21.4
74. Tibia: Circumference at the Nutrient Foramen: 8.8
75. Fibula: Maximum Length: 340*
76. Fibula: Maximum Diameter at Midshaft: 12.8*
77. Calcaneus: Maximum Length: 73.0
78. Calcaneus: Middle Breadth: 39.9*

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT, WEAR, AND PATHOLOGY: PERMANENT TEETH

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 3 / Date Oct. 2014

Burial/Skeleton Number Individual B /

Present Location of Collection Reinterred in Vault 3, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Occlusal surface wear:** use left teeth, following Smith (1984) for anterior teeth (code 1-8) and Scott (1979) for molars (code 0-10). If marked asymmetry is present, record both sides. Record each molar quadrant separate in the spaces provided (+) and the total for all four quadrants under "Total." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

		Tooth Presence	Development	Wear /Total	Caries	Abscess	Calculus/Affected
Maxillary Right	1 M^3						
	2 M^2						
	3 M^1						
	4 P^2						
	5 P^1						
	6 C						
	7 I^2						
	8 I^1						
Maxillary Left	9 I^1						
	10 I^2						
	11 C						
	12 P^1						
	13 P^2						
	14 M^1						
	15 M^2						
	16 M^3						

Series/Burial/Skeleton Vault 3, Indiv. B

Observer/Date D. Hacker, Oct. 2014

		Tooth Presence	Development	Wear /Total	Caries	Abscess	Calculus/Affected
Mandibular Left	17 M_3						
	18 M_2						
	19 M_1						
	20 P_2						
	21 P_1						
	22 C						
	23 I_2						
	24 I_1						
Mandibular Right	25 I_1						
	26 I_2						
	27 C						
	28 P_1						
	29 P_2						
	30 M_1						
	31 M_2						
	32 M_3						

Estimated dental age (juveniles only)__________

Supernumerary Teeth:

Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)
/		/		/	
/		/		/	

Comments:

~~No teeth recovered for this individual~~

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 / ____ Observer D. Hacker

Feature/Burial Number Vault 3 / ____ Date Oct 2014

Burial/Skeleton Number Individual Z / ____

Present Location of Collection Reinterred in Vault 3, Nov 2014

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	___	___	Sphenoid	___	___
Parietal	___	___	Zygomatic	___	___
Occipital	___	___	Maxilla	___	___
Temporal	___	___	Palatine	___	___
TMJ	___	___	Mandible	3	3

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	___	___	Os Coxae		
Scapula			Ilium	___	___
Body	___	___	Ischium	___	___
Glenoid f.	___	___	Pubis	___	___
Patella	___	___	Acetabulum	___	___
Sacrum	___	___	Auric. Surface	___	___

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	___	___
C2	___	___
C7	___	___
T10	___	___
T11	___	___
T12	___	___
L1	___	___
L2	___	___
L3	___	___
L4	___	___
L5	___	___

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	___/___	___/___
T1-T9	___/___	___/___

Sternum: Manubrium ___ Body ___

RIBS (individual)

	L	R
1st	___	___
2nd	___	___
11th	___	___
12th	___	___

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	___/___	___/___	___/___

Series/Burial/Skeleton Vault 3, Indiv Z
Observer/Date D. Hacker / Oct 2014

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus					
Right Humerus					
Left Radius					
Right Radius					
Left Ulna					
Right Ulna					
Left Femur		2	1	2	
Right Femur		2	1	2	
Left Tibia					
Right Tibia					
Left Fibula					
Right Fibula					

Left Talus____
Right Talus____
Left Calcaneus____
Right Calcaneus____

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	___/___	___/___	___/___
#Metacarpals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	___/___	___/___	___/___
#Metatarsals	___/___	___/___	___/___
#Phalanges	___/___	___/___	___/___

Comments:____

IMMATURE MEASUREMENTS RECORDING FORM

Site Name/Number 31BW787**2 / ______ Observer D. Hacker

Feature/Burial Number Vault 3 / ______ Date Oct 2014

Burial/Skeleton Number Individual Z / ______

Present Location of Collection Reinterred in Vault 3, Nov 2014

CRANIAL MEASUREMENTS

	L	M	R
1. Lesser Wing of the Sphenoid			
(a) Length:	______		______
(b) Width:	______		______
2. Greater Wing of the Sphenoid			
(a) Length	______		______
(b) Width:	______		______
3. Body of the Sphenoid			
(a) Length:		______	
(b) Width:		______	
4. Petrous and Mastoid Portions of the Temporal			
(a) Length:	______		______
(b) Width:	______		______
5. Basilar Part of the Occipital			
(a) Length:		______	
(b) Width:		______	
6. Zygomatic			
(a) Length:	______		______
(b) Width:	______		______
7. Maxilla			
(a) Length:	______		______
(b) Height:	______		______
(c) Width:	______		______
8. Mandible			
(a) Length of the Body:	______		______
(b) Width of the Arc:	______		______
(c) Full Length of Half Mandible:		______	

Series/Burial/Skeleton Vault 3, Indiv Z
Observer/Date D. Hacker / Oct 2014

POSTCRANIAL MEASUREMENTS

	L	R
9. Clavicle		
(a) Length:		
(b) Diameter:		
10. Scapula		
(a) Length (height):		
(b) Width:		
(c) Length of the Spine:		
11. Ilium		
(a) Length:		
(b) Width:		
12. Ischium		
(a) Length:		
(b) Width:		
13. Pubis		
(a) Length:		
14. Humerus		
(a) Length:		
(b) Width:		
(c) Diameter:		

	L	R
15. Ulna		
(a) Length:		
(b) Diameter:		
16. Radius		
(a) Length:		
(b) Diameter:		
17. Femur		
(a) Length:		98.8*
(b) Width:		24.1
(c) Diameter:		
18. Tibia		
(a) Length:		
(b) Diameter:		
19. Fibula		
(a) Length:		
(b) Diameter:		

Comments:

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT AND PATHOLOGY: DECIDUOUS TEETH

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 3 /

Date October 2014

Burial/Skeleton Number Individual Z /

Present Location of Collection Reinterred in Vault 3, Nov 2014

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Presence	Development	Caries	Abscess	Calculus/Affected
Maxillary Right	51 m²					
	52 m¹					
	53 c					
	54 i²					
	55 i¹					
Maxillary Left	56 i¹					
	57 i²					
	58 c					
	59 m¹					
	60 m²					
Mandibular Left	61 m²	2	3			
	62 m¹	5				
	63 c	5				
	64 i²	5				
	65 i¹	5				
Mandibular Right	66 i¹	5				
	67 i²	5				
	68 c	5				
	69 m¹	5				
	70 m²	1	3			

INVENTORY RECORDING FORM FOR COMPLETE SKELETONS

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 4 /

Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred, Vault 4 (November 2014)

CRANIAL BONES AND JOINT SURFACES

	L(left)	R(right)		L	R
Frontal	1	1	Sphenoid	1	1
Parietal	1	1	Zygomatic	1	1
Occipital	1	1	Maxilla	1	1
Temporal	1	1	Palatine	1	1
TMJ	1	1	Mandible	1	1

POSTCRANIAL BONES AND JOINT SURFACES

	L	R		L	R
Clavicle	1	1	Os Coxae		
Scapula			Ilium	1	1
Body	1	1	Ischium	1	1
Glenoid f.	1	1	Pubis	1	1
Patella	1	1	Acetabulum	1	1
Sacrum	1	1	Auric. Surface	1	1

VERTEBRAE (individual)

	Centrum	Neural Arch
C1	1	1
C2	1	1
C7	1	1
T10	1	2
T11	1	1
T12	1	1
L1	1	1
L2	1	1
L3	1	1
L4	1	1
L5	1	1

VERTEBRAE (grouped)

#Present/# Complete

	Centra	Neural Arches
C3-6	3 / 3	3 / 3
T1-T9	9 / 9	9 / 9

Sternum: Manubrium 1 Body 1

RIBS (individual)

	L	R
1st	2	2
2nd	2	2
11th	2	2
12th	2	2

RIBS (grouped)

#Present/# Complete

	L	R	Unsided
3-10	7 / 0	7 / 0	0 / 0

Series/Burial/Skeleton Vault 4 / Indiv. A

Observer/Date Vault 4, Indiv A

LONG BONES

	Proximal Epiphysis	Diaphysis Proximal Third	Diaphysis Middle Third	Diaphysis Distal Third	Distal Epiphysis
Left Humerus	1	1	1	1	1
Right Humerus	1	1	1	1	1
Left Radius	1	1	1	1	1
Right Radius	1	1	1	1	1
Left Ulna	1	1	1	1	1
Right Ulna	1	1	1	1	1
Left Femur	1	1	1	1	1
Right Femur	1	1	1	1	1
Left Tibia	1	1	1	1	1
Right Tibia	1	1	1	1	1
Left Fibula	1	1	1	1	1
Right Fibula	1	1	1	1	1

Left Talus 1

Right Talus 1

Left Calcaneus 1

Right Calcaneus 1

HAND (# Present/# Complete)

	L	R	Unsided
# Carpals	5 / 5	5 / 5	0 /
#Metacarpals	4 / 4	4 / 4	0 /
#Phalanges	7 / 7	7 / 7	0 /

FOOT (# Present/# Complete)

	L	R	Unsided
#Tarsals	7 / 7	6 / 6	0 /
#Metatarsals	5 / 5	5 / 9	0 /
#Phalanges	5 / 5	2 / 2	0 /

Comments:

~~** L5 and sacrum, although complete, never fused their neural arches ante-mortem. Individual suffered~~

from severe case of Spina Bifida Occulta.

CRANIAL AND POSTCRANIAL MEASUREMENT RECORDING FORM: ADULT REMAINS

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 4 /

Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred, Vault 4 (November 2014)

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Cranial Measurements

1. Maximum Cranial Length: 179.0
2. Maximum Cranial Breadth: 143.0
3. Bizygomatic Diameter: 124.0
4. Basion-Bregma Height: 137.0
5. Cranial Base Length: 97.0
6. Basion-Prosthion Length: 89.0
7. Maxillo-Alveolar Breadth: 50.0
8. Maxillo-Alveolar Length: 34.0
9. Biauricular Breadth: 119.0
10. Upper Facial Height: 75.4
11. Minimum Frontal Breadth: 95.0
12. Upper Facial Breadth: 101.0
13. Nasal Height: 26.0
14. Nasal Breadth: 22.9
15. Orbital Breadth: 39.7
16. Orbital Height: 35.1
17. Biorbital Breadth: 94.0
18. Interorbital Breadth: 20.3
19. Frontal Chord: 114.8
20. Parietal Chord: 104.6
21. Occipital Chord: 98.8
22. Foramen Magnum Length: 38.3
23. Foramen Magnum Breadth: 29.7
24. Mastoid Length: 34.1
25. Chin Height 43.1
26. Height of the Mandibular Body: 40.2
27. Breadth of the Mandibular Body: 10.2
28. Bigonial Width: 96.2
29. Bicondylar Breadth: 107.0
30. Minimum Ramus Breadth: 30.9
31. Maximum Ramus Breadth: 41.6
32. Maximum Ramus Height: 61.7
33. Mandibular Length: 72.8*
34. Mandibular Angle: 132.0*

Series/Burial/Skeleton Vault 4 / Indiv. A

Observer/Date D. Hacker/ Oct 2014

Record all measurements to the nearest millimeter; in the case of bilateral measurements, take measurement on the left side. If right side is substituted, place an (R) next to the the measurement.
If bones are fragmented, measurements should not be taken, but dimensions should be estimated for minor erosion or reconstruction; identify these with an asterisk"*"

Postcranial Measurements

35. Clavicle: Maximum Length: 146.5*
36. Clavicle: Ant.-Post. Diameter at Midshaft: 13.0
37. Clavicle: Sup.-Inf. Diameter at Midshaft: 10.4
38. Scapula: Height: 147.7
39. Scapula: Breadth: 96.3
40. Humerus: Maximum Length: 324.0
41. Humerus: Epicondylar Breadth: 57.0
42. Humerus: Vertical Diameter of Head: 45.6
43. Humerus: Maximum Diameter at Midshaft: 20.5
44. Humerus: Minimum Diameter at Midshaft: 17.7
45. Radius: Maximum Length: 224.5
46. Radius: Anterior-Posterior Diameter at Midshaft : 13.6
47. Radius: Medial-Lateral Diameter at Midshaft: 10.8
48. Ulna: Maximum Length: 240.0
49. Ulna: Anterior-Posterior Diameter: 17.4
50. Ulna: Medial-Lateral Diameter: 16.0
51. Ulna: Physiological Length: 206.2
52. Ulna: Minimum Circumference: 36.0
53. Sacrum: Anterior Length: 112.5
54. Sacrum: Anterior Superior Breadth: 113.4
55. Sacrum: Max. Transverse Diameter of Base: 46.9
56. Os Coxae: Height: 214.0
57. Os Coxae: Iliac Breadth: 145*
58. Os Coxae: Pubis Length: 85.0
59. Os Coxae: Ischium Length: 87.8
60. Femur: Maximum Length: 484.0
61. Femur: Bicondylar Length: 482.0
62. Femur: Epicondylar Breadth: 80.5
63. Femur: Maximum Diameter of the Femur Head: 44.7
64. Femur: Ant.-Post. Subtrochanteric Diameter: 27.2
65. Femur: Medial-Lateral Subtrochanteric Diameter: 26.6
66. Femur: Anterior-Posterior Midshaft Diameter: 32.7
67. Femur: Medial-Lateral Midshaft Diameter: 26.6
68. Femur: Midshaft Circumference: 90.0
69. Tibia: Length: 372.0
70. Tibia: Maximum Proximal Epiphyseal Breadth: 74.0
71. Tibia: Maximum Distal Epiphyseal Breadth: 50.5
72. Tibia: Max. Diameter at the Nutrient Foramen: 35.8
73. Tibia: Med.-Lat. Diameter at Nutrient Foramen: 25.6
74. Tibia: Circumference at the Nutrient Foramen: 101.0
75. Fibula: Maximum Length: 360.5
76. Fibula: Maximum Diameter at Midshaft: 13.7
77. Calcaneus: Maximum Length: 80.8
78. Calcaneus: Middle Breadth: 42.6

DENTAL INVENTORY RECORDING FORM
DEVELOPMENT, WEAR, AND PATHOLOGY: PERMANENT TEETH

Site Name/Number 31BW787**2 /

Observer D. Hacker

Feature/Burial Number Vault 4 /

Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred, Vault 4 (November 2014)

Tooth presence and development: code 1-8. For teeth entered as "1" (present, but not in occlusion), record stage of crown/root formation under "Development." **Occlusal surface wear:** use left teeth, following Smith (1984) for anterior teeth (code 1-8) and Scott (1979) for molars (code 0-10). If marked asymmetry is present, record both sides. Record each molar quadrant separate in the spaces provided (+) and the total for all four quadrants under "Total." **Caries:** code each carious lesion separately (1-7); **Abscesses:** code location (1-2). **Calculus:** code 0-3, 9. Note surface affected (buccal/labial or lingual).

	Tooth	Tooth Presence	Development	Wear	Total	Caries			Abscess	Calculus	Affected
Maxillary Right	1 M^3	2	4	all 1	4	0			0	1	buc./ling.
	2 M^2	2	14	1:1;3:3	8	0			0	1	buc./ling.
	3 M^1	4									
	4 P^2	2	14	2	2	2			0	1	buc./ling.
	5 P^1	2	14	3	3	0			0	1	buc./ling.
	6 C	2	14	4	4	0			0	1	buc./ling.
	7 I^2	2	14	4	4	2			0	1	buc./ling.
	8 I^1	2	14	6	6	2			0	1	buc./ling.
Maxillary Left	9 I^1	2	14	6	6	0			0	1	buc./ling.
	10 I^2	2	14	3	3	0			0	1	buc./ling.
	11 C	2	14	4	4	0			0	1	buc./ling.
	12 P^1	2	14	3	3	0			0	1	buc./ling.
	13 P^2	2	14	3	3	0			0	1	buc./ling.
	14 M^1	2	14	all 4	16	0			1+2	1	buc./ling.
	15 M^2	2	14	all 4	16	0			0	1	buc./ling.
	16 M^3	4				0			1	0	

Series/Burial/Skeleton Vault 4, Indiv A

Observer/Date D. Hacker, Oct. 2014

		Tooth Presence	Development	Wear	/Total	Caries			Abscess	Calculus/	Affected
Mandibular Left	17 M_3	2	14	1:1:4:4	11	0			0	1	buc./ling.
	18 M_2	2	14	3:3:4:4	14	2			0		
	19 M_1	2	14	all 10	40	0			0		
	20 P_2	2	14	1	1	0			0	1	buc./ling.
	21 P_1	2	14	2	2	0			0	1	buc./ling.
	22 C	2	14	1	1	0			0	1	buc./ling.
	23 I_2	4									
	24 I_1	2	14	5	5	0			0	1	buc./ling.
Mandibular Right	25 I_1	2	14			0			0	1	buc./ling.
	26 I_2	2	14			0			0	1	buc./ling.
	27 C	2	14			0			0	1	buc./ling.
	28 P_1	2	14			0			0	1	buc./ling.
	29 P_2	2	14			0			0	1	buc./ling.
	30 M_1	2	14			0			0	1	buc./ling.
	31 M_2	4									
	32 M_3	2	14	all 1	4	0			0	1	buc./ling.

Estimated dental age (juveniles only)__________

Supernumerary Teeth:	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)	Position between teeth	Location (1 - 4)
	__/__	__	__/__	__	__/__	__
	__/__	__	__/__	__	__/__	__

Comments:

DENTAL MEASUREMENTS AND MORPHOLOGY RECORDING FORM

Site Name/Number 31BW787**2 / Observer D. Hacker

Feature/Burial Number Vault 4 / Date Oct 2014

Burial/Skeleton Number Individual A /

Present Location of Collection Reinterred in Vault 4, Nov 2014

Dental Measurements

Record left side of arcade only; substitute antimere when left not observable.

Maxilla

Tooth	I^1	I^2	C	PM^1	PM^2	M^1	M^2	M^3
Mesiodistal diameter	8.1	7.2	8.2	6.7	6.5	10.5	9.3	
Buccolingual diameter	6.9	6.7	8.5	8.6	8.8	11.1	10.6	
Crown height	9.5	9.6	9.8	6.2	7.2	6.5	7.3	

Mandible

Tooth	M_3	M_2	M_1	PM_2	PM_1	C	I_2	I_1
Mesiodistal diameter	10.0	10.1		6.5	6.9	6.9		4.7
Buccolingual diameter	9.1	9.6		7.3	7.0	7.6		5.7
Crown height	5.7	7.3		6.6	8.0	9.7		6.2

Archaeological Investigations

Historical Research

Preservation

Education

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Museum Support Programs

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